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The Snail Polygyra thyroidus as a Mycophagist

FRED T. WOLF AND FREDERICK A. WOLF

(WITH ONE FIGURE)

It has been known for many years that fungi represent an important source of food for molluscs. On the basis of their food requirements, Stahl (1888) divided the slugs into two categories: "omnivora," which show no marked preferences in their choice of food, and "specialists," which feed almost entirely upon fungi. The slugs *Limax maximus*, *L. cereus*, and *Arion subfuscus* were found by Stahl to be mycophagous. Voglino (1895) has observed that the spores of a number of agarics, including *Tricholoma humile*, *Mycena alcalina*, *Lactarius deliciosus*, *Russula* sp., and *Inocybe fastigata*, after passage through the digestive tract of slugs, are still capable of germination.

The extensive researches of Gain (1891), Buller (1909, 1922), Benecke (1918), and Elliott (1922) on the feeding habits of certain of the species of *Limax*, *Agrolimax*, *Amalia*, and *Arion* have indicated that approximately a hundred species of such fleshy basidiomycetous fungi as *Armillaria*, *Boletus*, *Collybia*, *Coprinus*, *Cortinarius*, *Hypholoma*, *Laccaria*, *Lactarius*, *Lepiota*, *Paxillus*, *Psalliota*, *Russula*, and *Tricholoma* are readily eaten by slugs. These animals also consume with avidity other basidiomycetes as *Polyporus squamosus*, *P. sulphureus*, and *Lycoperdon caelatum*, and a number of ascomycetous fungi including *Peziza vesiculosa*, *P. aurantiaca*, *P. badia*, *Bulgaria polymorpha*, and *Morchella esculenta*. It is of interest to note that slugs are apparently capable of eating without the slightest ill effects the fruiting bodies of *Amanita caesarea*, *A. mappa*, *A. muscaria*, *A. pantherina*, *A. phalloides*, *A. porphyrea*, *A. pustulata*, *A. rubescens*, *A spissa*, *A. strobiliformis*, and *A. umbrina*, all of which are poisonous to man (Stahl, 1888; Voglino, 1895: Benecke, 1918; Buller, 1909, 1922).

Apparently very little is known concerning the feeding of snails upon fungi. Gain (1891) has found that a number of fleshy basidiomycetes are readily eaten by the snails *Zonites nitidulus*, *Helix arbustorum*, *H. aspersa*, *H. cantiana*, *H. hispida*, *H. hortensis*, *H. nemoralis*, *H. rotundata*, *H. sericea*,

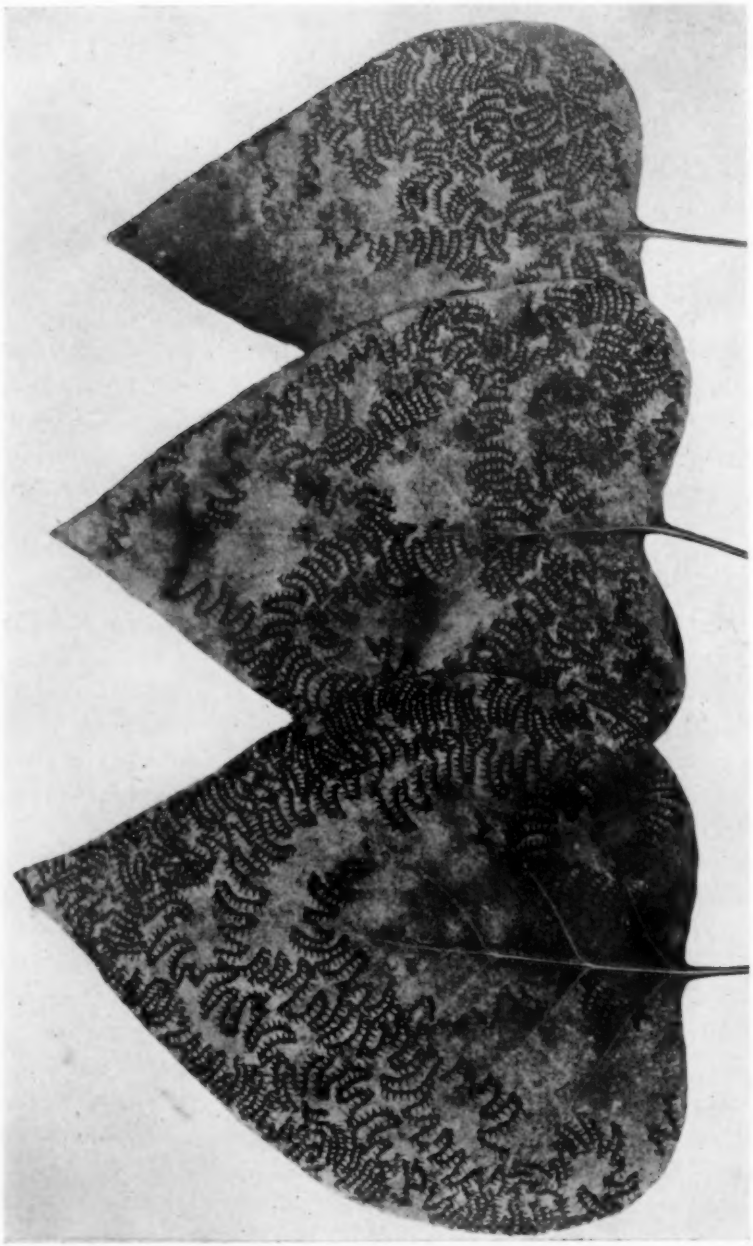

Fig. 1. Leaves of lilac infected with *Microsphaera alni*, showing the feeding track made by *Polygyra thryoidus* (about two thirds natural size).

and *H. virgata*. Certain observations by Ludwig (1891) are of especial interest in connection with the present paper, since he noted that a number of plant parasitic fungi are eaten by snails. These included the downy mildew *Peronospora gangliformis* on *Cirsium oleraceum*, two powdery mildews, *Sphaerotheca castagnei* on hops (*Humulus lupulus*), and *Erysiphe horridula* on *Symphytum officinale*, and several species of rust fungi. The powdery mildew fungus on hops was eaten by *Helix frulicum*, while the *Erysiphe* was consumed by *Succinea putris*.

In the summer of 1938, the foliage of lilac, *Syringa vulgaris*, in certain yards in Durham, N. C. was infected by the powdery mildew *Microsphaera alni* (DC.) Wint. to the extent that most of the leaves were rather uniformly covered with the characteristic profuse whitish powdery coating. On a few leaves however, there occurred peculiar serpentine markings as though the coating had been etched. The appearance of such leaves, shown in Fig. 1, strongly suggested the possibility that some small animal had eaten away the fungus coating and had thus made the markings. To test this assumption examinations were made at night with the result that snails were noted to be present upon leaves bearing designs that appeared to have been freshly made. Furthermore when some of these snails were transferred to leaves uniformly covered with mildew and observations were then made after a brief period, it was convincingly apparent that the intricate patterns were produced by these animals while feeding. The snails were identified as *Polygyra thyroidus* Say by Mr. G. W. Wharton* of the Department of Zoology. This species is described by Pratt (1935) and was illustrated, under the name *Helix thyroides* Say, in the monograph by Tryon (1887).

Patterns of identical design have been observed to occur abundantly on several species of unidentified crustose lichens occurring on trees within the Duke Forest and on the upper surface of the sporophores of *Polyporus picipes* Fr.

The designs made by *Polygyra thyroidus* are very similar in appearance to those of *Helix aspera* as illustrated by Taylor (1894). The formation of these designs is the result of the following procedures as determined by direct observation of the process: the snail extends its body from the shell and, while moving the anterior part in a clockwise direction, removes the fungus coating, using successive strokes of the radula. A narrow arc-shaped band, devoid of fungus, is thereby produced. Then the snail moves forward approximately an eighth of an inch and clears a similar

* Thanks are extended Mr. G. W. Wharton for this identification and for the specimens of *Polyporus picipes*.

arc, moving the anterior part of its body in a counter-clockwise direction. Although the snail moves in a more or less straight line the serpentine feeding track becomes the resultant of the two synchronized activities, feeding and moving forward. The symmetrically disposed spines on one margin of the track are produced by the radular teeth, the apices of the spines being in the direction of advance of the snail.

In order to determine whether fungi other than *Microsphaera alni* were eaten by *P. thyroidus*, a number of snails were secured and placed in small glass jars into which various fungi were introduced. It was found that *Uncinula australiana* McAlpine on *Lagerstroemia indica*, *Erysiphe cichoracearum* DC. on *Zinnia elegans*, and *Erysiphe polygoni* DC. on *Trifolium pratense* were readily eaten by *P. thyroidus*. Patterns similar to those on lilac were produced in each case. Fruiting bodies of the slime mold, *Fuligo septica* Gmelin, the ascomycete, *Hypomyces lactifluorum* (Schw.) Tul. parasitic on *Russula* sp., and the basidiomycetes, *Cantharellus aurantiacus* Fr., *Boletus* sp., *Lactarius piperatus* (L.) Pers., *Russula emetica* Fr., *Russula virescens* Fr., and *Amanita verna* Bull. were also eaten by these snails. They also consumed the lichen, *Sticta herbacea* (Huds.) Ach.

Although the number of organisms tested was rather small, it is perhaps worthy of note that not a single one of the species tested was refused by Polygyra. Furthermore, in cases in which the snails were permitted to choose between two or more fungi simultaneously present in the jars, a marked preference for *Microsphaera alni* was shown. All of the fungi tested were eaten by *P. thyroidus* in preference to lettuce or other chlorophyll-containing food. It is evident, therefore, that *P. thyroidus* should be considered as mycophagous according to the classifications of Stahl (1888) and Benecke (1918).

There are a number of problems of general biological and theoretical interest about which inferences may be drawn on the basis of these observations. One of these is concerned with the possible spread of powdery mildew by means of snails. Inasmuch as the actual distance travelled by a snail within a given time interval is so short, and since an examination of the contents of the digestive tract and of the fecal pellets of *P. thyroidus* failed to give definite evidence that mildew spores pass through intact, it does not seem probable that snails are of appreciable importance in the dissemination of powdery mildews.

Another problem, of interest to zoologists, is concerned with the means by which a land snail locates the powdery mildew on leaves several feet above the ground. The experiments of Buller (1922) with the slug, *Limax maximus*, have clearly demonstrated the perception by this animal

of chemotropic stimuli exerted by such fungi as *Phallus impudicus, Boletus scaber, Cortinarius caninus, Russula heterophylla,* and *R. nigricans.* The odors of these fungi were found to be perceived by *L. maximus* at distances ranging from 10 to 21 feet. Whether or not the attraction of snails to fungi is to be explained solely on the basis of chemotropism can be settled only after further experimentation.

SUMMARY

The snail *Polygyra thyroidus* Say was observed under natural conditions to eat the powdery mildew *Microsphaera alni* on lilac, in consequence of which a feeding track of peculiar and characteristic design is produced on lilac leaves. Similar tracks were found on crustose lichens and on the sporophores of *Polyporus picipes.* Under laboratory conditions, *P. thyroidus* was found to eat *Uncinula australiana* on *Lagerstroemia indica, Erysiphe cichoracearum* on *Zinnia elegans, E. polygoni* on *Trifolium pratense,* making similar markings. It also consumed *Fuligo septica, Hypomyces lactifluorum* on *Russula* sp., *Stictis herbacea, Cantharellus aurantiacus Boletus* sp., *Lactarius piperatus, Russula emetica, R. virescens,* and *Amanita verna. P. thyroidus* is decidedly mycophagous in regard to its food preferences.

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Studies in the Ericales IV. Notes on Chimaphila, Gaultheria and Pernettya in Mexico and Adjacent Regions

W. H. Camp

An accumulation of material received for identification as well as specimens collected during my own field studies in the state of Oaxaca, Mexico, during the winter of 1936–1937, make it advisable at the present time to publish brief notes on a miscellany of certain American ericaceous genera and species. All specimens cited, unless otherwise noted, are in the Britton Herbarium at the New York Botanical Garden.

CHIMAPHILA

Chimaphila maculata (L.) Pursh, Fl. Am. Sept. 300. 1814.

Chimaphila maculata acuminata Lange, Vidensk. Meddel. **1867:** 112. 1868.

Chimaphila acuminata (Lange) Rydb. N. Am. Flora **29:** 31. 1914.

Chimaphila guatemalensis Rydb. N. Am. Flora **29:** 32. 1914.

Chimaphila dasystemma Torr.; Rydb. N. Am. Flora **29:** 32. 1914.

The entering wedge on the break-up of this species in Mexico and Central America was begun by Lange with *C. maculata acuminata* and continued by Rydberg (N. Am. Flora **29:** part 1. 1914) with the elevation of this variety to specific rank and the addition of *C. guatemalensis* and *C. dasystemma* as new. Being familiar with *C. maculata* as it occursthroughout its range in the United States and having seen it on various occasions in Mexico, as well as having the types of *C. dasystemma* and *C. guatemalensis* available, in addition to a considerable series of the several species involved, I am unable to see a greater degree of variation within the bulk of the Mexican and Central American material of this group than that within the material from the United States. It is to be admitted that there exists a tendency for some of the Mexican specimens to be somewhat more narrow-leaved and, on this basis, it might be easy to maintain them as *C. maculata acuminata* Lange, were it not for the fact that, in this region, others of the specimens are wider-leaved and less acuminate than some scattered throughout the range of the species in the United States. Too, it must be remembered that in Mexico this species grows at much greater altitudes than in the United States. This would tend somewhat to modify the leaf form since in Mexico it grows mainly between the elevation of 5000 and 8000 feet.

The type of *C. dasystemma* is a small, oval-leaved specimen, obviously abnormal and not matched in any other Mexican material, but is matched by homologous, abnormal forms from the United States. The type of *C.*

guatemalensis, characterized by long tubules on its anthers, is merely a robust specimen, matched, or even exceeded, in this character by our own material from various stations in the eastern United States. It is therefore thought best to return these entities to the basic species and consider them merely as biotypic parts of a more widespread, ancient and not particularly variable species, *Chimaphila maculata* Pursh.

CHIMAPHILA MENZIESII (R. Br.) Spreng.

During the above study, several specimens placed under *C. dasystemma* by Rydberg were seen which did not seem to be conspecific with *C. maculata* (*sensu lata*). Examination indicated that they were unusually robust individuals of *C. Menziesii*. A further study of this species revealed a rather continuous variation of robustness and degree of maculation from its northern limits southward through Washington, Oregon, and California, culminating in the very robust and considerably maculated forms in Mexico. Having personally studied this species as it occurs in the field in the Pacific Northwest, I admit that the Mexican material is quite different from it, but the Californian material intergrades to such an extent that no sharp line of demarcation may be drawn between the forms. Here again, I am, as yet, not inclined to recognize any taxonomic entities where such intergrades, seemingly the result of differences in water supply, insolation, and altitude, are to be found.

The specimens which increase the range of *Chimaphila menziesii* are as follows: MEXICO. Sonora: Pineridge Pass, *Hartman* 351, Dec. 17, 1890 (in fruit). Jalisco: Sierra du Narayit (Territoire Huichol), *Leon Diquet*, without number of date (in bud).

The extension of range of *C. menziesii* into Mexico is not surprising, but the inclusion of certain other described species under *C. maculata* will no doubt, meet with some disapproval. In this connection, however, it must be recorded that field study, at least in Oaxaca, of various species of Mexican plants segregated by earlier writers, leads me to conclude that there is a much closer affinity between certain members of this flora and that of the United States than has previously been supposed. Also, the complexity of the Oaxacan flora in many groups would seem to indicate that this part of southern Mexico, with its great ranges of mostly non-volcanic mountains, is one of the critical regions in a study of the dispersal of the floras of Central America, the Caribbean flora, the derived floras of north-central Mexico and the ancient Tertiary flora of the southern Appalachians. Except for brief mention, further discussion of this topic is outside the scope of the present paper.

GAULTHERIA

In preparation for a more complete review of the Ericaceae (*sensu lata*), Dr. Sleumer, of Berlin, from time to time has published miscellaneous papers relating to the genera and species of this group. In the identification of certain specimens of the genus *Gaultheria* it was necessary to consult and, if possible, follow his work. I have not always been able to do this because it is my opinion that Sleumer, at times, has misinterpreted certain American species, possibly because he has never had the privilege of seeing them growing in the field. A discussion of selected species follows.

In a recent revision of the species of *Gaultheria* of Mexico and Guatemala (Notizbl. **12:** 285–287. 1935), Sleumer, in his key, divides that group of species which generally are without glandular pubescence on the inflorescence on the basis of the shape of the calyx-lobes, following the lead of both Small (N. Am. Flora **29:** 74. 1914) and Standley (Contrib. U. S. Natl. Herb. **23:** 1092. 1924). In this way *G. acuminata* Cham. & Schlecht. is separated by its supposedly deltoid, acute calyx-lobes from the other members of the group with elongate-deltoid, acuminate calyx-lobes. It is my opinion that the retention of this as a key character is most unfortunate since it seems clear after examination of a considerable number of specimens and study of these plants as they occur in the field, that it is a distinction without a difference.

Actually, to return to the genus as a whole, so far as I can determine, there are two rather well defined groups in the Mexican species of *Gaultheria:* (1) The ACUMINATAE, in which the rachis is either glabrous or finely puberulent (or rarly with minute glands), and (2) The ODORATAE, in which the rachis is hirsute and in all but a few species with the hairs gland-tipped.

THE ACUMINATAE

In most treatments, *G. acuminata* Cham. & Schlecht. is listed as having a distribution limited to the state of Vera Cruz. Actually, it is more widespread, to my present knowledge ranging from Vera Cruz and Oaxaca to central Mexico. The supposedly restricted range of this species is due, probably, to confusion with *G. nitida* Benth.

This last (*G. nitida*), has been placed in synonymy under *G. ovata* DC. by Sleumer. Not having seen the type of *G. ovata*, I am unable either to confirm or disagree with this decision. However, if the two are synonymous, I can not agree with the position in the key as assigned by Sleumer, for the corollas of the type collection of *G. nitida* are somewhat densely puberulent and not glabrous as he has indicated. To be sure, the pubescence is not prominent, but the fact that it is ferruginous causes it to blend

so well with the color of the corollas on this century-old specimen that it might easily be missed.

Since I have not studied types of either *G. ovata* DC, or *G. laevigata* Mart. & Gal., I am unable at present to dispose of them in conjunction with *G. nitida* Benth. and *G. Nelsonii* Small, all more or less closely related to the earlier *G. acuminata*. *G. nitida*, if one may judge from the type, differs from *G. acuminata* at least in the absence of punctations on the lower surface of its leaves, a character shared (*ex descr.*) by *G. laevigata* Mart. & Gal. These "punctations," in reality the bases of either glandular or non-glandular, deciduous hairs, have rarely been noted as having taxonomic significance. I am not certain how much weight should be placed on such a character but specimens at hand would seem to indicate that *G. nitida* is a separate entity, closely related to, but distinct from *G. acuminata*. I therefore propose the following:

GAULTHERIA ACUMINATA Schlecht. & Cham. var. **nitida** (Benth.) Camp, stat. nov.

Gaultheria nitida Benth. Pl. Hartw. 45. 1840.

MEXICO. Hidalgo: "in loco 'Banco' dicto," *Hartweg* 344, 1840 (type of *G. nitida* Benth.). Puebla: Honey Station, 5600 ft. *Pringle 8961*. Oaxaca: High pass between Tamazulapa and Ayutla (near Zempoaltepetl), *Camp 2724, 2726*.

A further problem is the disposition of *G. Nelsonii* Small. This species is characterized by having its inflorescence and corolla completely glabrous. While possible that such characteristics may be a further variation of *G. acuminata*, it is, nevertheless, strongly suspected that *G. Nelsonii*, with its completely glabrous inflorescence and corollas and somewhat oblong leaves is distinct from the complex of forms surrounding *G. acuminata*. Until the type of *C. laevigata* is seen, the writer is unable to ascertain whether Sleumer is correct in placing this species in synonymy under *G. laevigata* Mart. & Gal.

In the group of specimens related to the ACUMINATAE on the basis of the nature of the pubescence of the inflorescence, the following unusual ones were noted, being sufficiently different to warrant the description of the following two new species.

Gaultheria Pringlei Camp, sp. nov.

Frutex 1–2.5 m., ramis glabris; folia ovato-oblonga, petiolo 5–9 mm. longo, basi rotundata vel late cuneata, apice abrupte acuminata, subcoriacea, 6–10 cm. longa, 2.5–5 cm. lata, supra obscure punctata, subtus in foliis adultis punctata, sed in foliis junioribus dense ferrugineo-glandulosa, margine obscure

serrulata; racemi laterales et subterminales 12–20-flori, 7–8 cm. longi; rachis albido-puberula, supra medium glandulosa, pedicelli graciles albido-puberuli 4–8 mm. longi, bractea glabra; calyx campanulatus, lobis 5 deltoideis acuminatis puberulis margine subciliatis 1.5 mm. longis; corolla urceolata apice manifeste contracta circ. 5.5 mm. longa, sparse glanduloso-hirsuta; stamina 10, filamentis basi dilatatis sparse vel dense pilosulis circ. 2 mm. longis, antheris circ. 2 mm. longis; ovarium depresso-globosum, dense ferrugineo-pilosum, stylo glabro.

Gaultheria Pringlei is a coarse shrub to 2.5 meters, its leaves ovate-oblong with petioles 5–9 mm. long, basally rounded to broadly cuneate, apically abruptly acuminate, subcoriaceous, 6–10 cm. long and 2.5–5 cm. wide, their upper surfaces obscurely punctate with deciduous gland-hairs, the lower surface of the adult leaves punctate, in the younger densely set with minute gland-hairs, the margin obscurely serrulate; the racemes lateral and subterminal 7–8 cm. long, bearing 12–20 flowers; the rachis densely white-puberulent, bearing scattered gland-hairs about 0.25 mm. long on its upper portion, or in specimens other than the type, extending even to the base; pedicels slender, white-puberulent, 4–8 mm. long, the basal bracts glabrous, somewhat variable, but generally broad and only about half as long as the pedicels or rarely as long; calyx campanulate, its 5 lobes deltoid-acuminate, puberulent and subciliate on the margin, the lobes about 1.5 mm. long at anthesis; corolla urceolate and apically contracted, about 5.5 mm. long, sparsely glandular-hirsute; stamens 10, filaments basally dilated, sparsely to densely pilose, about 2 mm. long, anthers about 2 mm. long; ovary depressed-globose, densely ferrugino-pilose, style glabrous.

MEXICO. Vera Cruz: Sand Bluffs near Jalapa, 4000 feet, *C. G. Pringle 8336*, May 15, 1900 (type, N. Y.); Acultzinco, *E. Matuda 1159(B)*.

At first glance, if judged only by the foregoing description, it would seem that *G. Pringlei*, on the basis of the gland-hairs found on the rachis, might perhaps be placed in the ODORATAE rather than the ACUMINATAE. This glandular pubescence, however, is of a type totally different from that investing many of the members of the ODORATAE. Neither is it to be thought that this species is intermediate between these species groups and it is altogether possible that *G. Pringlei* and the next may yet be considered as sections different from either of the others now recognized.

In connection with this discussion, it might be noted that the type specimen cited above (*Pringle 8336*) in a measure was responsible for a slight misinterpretation of *G. acuminata* by the late Dr. J. K. Small. In his description of this last species (N. Am. Flora **29:** 76. 1914) he states that the

staminal filaments are glabrous. His dissections of this specimen (which he placed in *G. acuminata*) were mounted in glycerin-jelly, a medium which occasionally obscures certain types of pubescence. A reexamination of new dissections as well as the original by means of special lighting, reveals a reasonably abundant pubescence on this structure.

Gaultheria chiapensis Camp, sp. nov.

Frutex, ramis glabris; folia ovata vel lanceolata, petiolo 3–7 mm. longa, basi rotundata, apice sub-acuminata, sub-coriacea, 4–10 cm. longa, 1.5–3.5 cm. lata, supra glabra, subtus dense punctata, margine serrulata; racemi laterales et subterminales 20–30-flori, 6–10 cm. longi; rachis albido-puberula; pedicelli graciles albido-puberuli 5–9 mm. longi, bractea glabra 6–8 mm. longa; calyx campanulatus, lobis 5 acutis puberulis, circ. 2 mm. longis margine subciliatis; corolla urceolata apice manifeste contracta circ. 5 mm. longa, puberula et sparse hirsuta, eglandulosa; stamina 10, filamentis basi dilatatis pilosulis circ. 2 mm. longis, antheris circ. 2 mm. longis; ovarium globosum, dense albido-pilosum, stylo glabro.

Gaultheria chiapensis is apparently a coarse shrub, with glabrous branches, leaves narrowly ovate or sometimes lanceolate as on the type, petioles 3–7 mm. long, basally rounded, apically acute or subacuminate to a calloused tip, subcoriaceous, 4–10 cm. long, 1.5–3.5 cm. wide, glabrous above and densely puncate below, the margin serrate; racemes lateral and subterminal, 20–30 flowered, or in others than the type fewer flowered, 6–10 cm. long; rachis white-puberulent; pedicels slender, white-puberulent, 5–9 mm. long, bracts glabrous, 6–8 mm. long; calyx campanulate, lobes 5, acute, puberulent, about 2 mm. long, their margins subciliate; corolla pink(?), urceolate, apically manifestly contracted, about 5 mm. long, puberulent and sparsely hirsute, the hairs eglandular; stamens 10, filaments basally dilated, pilose, about 2 mm. long, anthers about 2 mm. long; ovary globose, densely white-pilose, style glabrous.

MEXICO. Chiapas: "Cero de Mapastepec," *E. Matuda 2041*, January, 1938 (type, N. Y.); Mt. Pasitar(?), *Matuda 1009;* "Cero de laguna," Mapastepec, 2100 meters, *Matuda 2041-A* (Herb. Univ. Mich.).

This last collection (*Matuda 2041-A*), first issued under the collector's number *2041,* but changed before being called to my attention, is mainly in fruit and while perfectly conspecific with the type—the remaining corollas matching exactly—is interesting in that it shows what probably is an extreme condition of the species. This specimen consists of a portion of a flowering branch about 30 cm. long and bearing not less than 20 racemes, most of which approach the size given as the upper limit of those on the type. The leaves are much more broadly oval than those of the type

and where fully developed, are 5–7 cm. long and 4–4.5 cm. wide. The plant is therefore a coarse shrub probably not less than 1 m. high and may even exceed 2 meters.

THE ODORATAE

GAULTHERIA ODORATA Willd.

Typical of the Mexican and Central American species of this group is *G. odorata*, the type of which came from Venezuela. It seems to be fairly common in the mountains of northern South America and ranges from there northward through Central America into Mexico. With the specimens immediately available, it would appear that *G. odorata*, typically a coarse shrub, with abundant, glandular hairs on the rachis, pedicels, calyx, and corolla, is fairly common in Guatemala but known to me from Mexico only by the following: *Seler 2097*, from Chiapas; and *Conzatti 4110*, from the District of Teotitlán, Oaxaca. In his revision, Sleumer (loc. cit.), has united *G. hidalgensis* Loes. with this species. Not having seen the type of this last, I am unable to check certain characters important in the correct understanding of this group, but I am inclined to agree with him in his conclusions.

GAULTHERIA LANCIFOLIA Small.

The glandular pubescence of the calyx lobes (or rather, the nearly complete lack of it) plays an important role in the interpretation of this species, which was also placed in synonymy under *G. odorata* by Sleumer. It is obvious that the two are closely related and that *G. lancifolia* is a derivative at the northern edge of the range of *G. odorata*, but is easily separable from the basic species on the nature of its calyx. Typically, the calyx of *G. lancifolia* is completely glabrous, except for a line of cilia along the margin of its lobes. The sudden break at the line of the receptacle from the densely puberulent pedicels, thickly set with coarse gland-hairs, to the glabrous calyx-base is striking and a feature not seen in typical material of *G. odorata*. To be sure, there is some variation for occasional calyces (as a small percentage on the type specimen) bear a few short scattered gland-hairs, but these are always near the *apex of the calyx lobes*, in contradistinction with *G. hidalgensis* where (*ex descr.*) they are *more abundant* and confined to the *base of the calyx*, and with *G. odorata* where there is a *complete and abundant* vesture of these hairs on the calyx.

Specimens examined and typical of *G. lancifolia* Small are as follows: MEXICO. Chihuahua: 65 mi. E. of Batopilas, *Goldman 182*. Mexico: Salto de Agua, *Purpus 1774* (type); Nanchititla, *Hinton 7356*. Oaxaca: Zempoaltepetl, middle to upper slopes, *Camp 2662;* ibid., lower slopes,

Camp 2699; high pass between Tamazulapa and Ayutla (near Zempoaltepetl), *Camp 2730.*

Typically, *G. lancifolia* is a rather coarse shrub, sometimes over 1 meter in height, with white or pink corollas. One specimen [*Camp 2662*, Sheet II, collected from the same plant as *Camp 2662*, Sheet I (both in Herb. N. Y. Bot Gard.), but from a stunted, lower branch in shade], while retaining the typical glands on the rachis, has them reduced and rare on the pedicels (the puberulence of the rachis and pedicels as well as the glabrescence of the calyx, is typical), a variation which is to be expected in this species. Also the plants may be lower, as *Camp 2699*, sometimes only half a meter high when growing in dry and exposed habitats. Here the leaves are narrowed, much resembling the type specimen. At higher and, therefore, moister elevations the leaves are broader and closely resemble those of *G. odorata.*

With *G. lancifolia* may be placed this otherwise puzzling form:

GAULTHERIA LANCIFOLIA Small var. **dulcis** Camp, var. nov.

A speciei calyce dense puberulo differt.

Gaultheria lancifolia var. *dulcis* is a coarse shrub 1–2 m. high with leaves closely resembling the species; the gland-hairs on the pedicels are reduced, shorter than typical or even nearly wanting. Its principal point of difference is in having a densely white-puberulent calyx.

GUATEMALA. Dept. Chimaltenango: Santa Elena, alt. 3000 meters, *Skutch 338*. EL SALVADOR. Volcan de San Salvador, alt. 1000 to 1800 meters, *Paul C. Standley 22944*, April 7, 1922 (type, N. Y.); ibid. *Calderon 477.*

Although somewhat intermediate between typical *G. lancifolia* and *G. odorata* it is thought best to keep this material separate from the species until connecting forms can be found. The puberulence on its calyx is a character often met with in *G. odorata* but the sparsely scattered gland-hairs on its corolla, the almost total lack of them on the calyx, and their reduction in density and size on the pedicels and rachis would seem to place it in closer affinity with *G. lancifolia*. The name is in reference to a note on the type specimen which states that the "fruit" (calyx) is sweet, a character, however, not unusual to this group of species.

GAULTHERIA HARTWEGIANA Loes.

Another species placed in synonymy under *G. odorata* by Small, Standley, and Sleumer is *G. Hartwegiana* Loes. If the original description only were available, it would be easy to reduce this species, but I have examined a photograph of isotype material in the Berlin Herbarium as well as our

own excellently preserved and adequate portion of the type collection (*Hartweg 541*), neither of which agrees in all respects with the original description. It is obvious that a specimen in addition to the type was used to draw up the description (*Seler 2379*, which I have not seen). The largest leaves on the isotypes are rarely over 3 cm. long and never over 2.5 cm. wide, approaching the lower limits set in the original description, which states that they are 2.5–5.5 cm. long and 1.2–3.3 cm. wide. The Berlin specimen, its leaves and stems obviously damaged before collection, is of little help, but our specimen would seem to indicate that the plant was not particularly tall, probably strict, and not spreading, as is typical for *G. odorata*. In our specimen, the leaves, in addition to being smaller, are in proportion shorter and more deeply cordate than is typical for *G. odorata*.

Also interesting in regard to this specimen is its locality of collection. The original description cites it as, "Hab. in Guatemala ad Quezaltenango," whereas the label on our specimen notes it as having been collected "In Mexico, in montibus prope Quezaltenango, Guatemala." Since Mexican territory is only some 60–70 kilometers distant from this locality, it is possible that the temporary headquarters where the specimens were sorted was Quezaltenango but that the collection actually was made in Mexico or at least near the international boundary. This particular region along the border being botanically but little explored, additional material may yet be found which will further authenticate this species.

I maintain that *G. Hartwegiana* Loes. is a valid species, closely related to, but distinct from *G. odorata* Willd. because the leaf-form of *G. Hartwegiana* is obviously different from the general run of the material of *G. odorata* in Mexico and Central America, and because its entire inflorescence is much more densely puberulent than that of *G. odorata* (in which the bracts of the material from Mexico and South America are almost glabrous, except for the marginal cilia and gland-hairs).

GAULTHERIA HIRTIFLORA Benth.

Although a certain amount of confusion is bound to occur between *G. odorata* and *G. hirtiflora*, this last species is quite characteristic, even if a close derivative of *G. odorata*. No single character could be found which would serve absolutely to distinguish the two but *G. hirtiflora* with its nearly deltoid, deeply cordate leaves pubescent with long, persistent gland-hairs on their lower surfaces, is almost unmistakable. Too, the glandular pubescence of this species is much more developed than on *G. odorata*, being more crowded, longer, and with larger glands throughout the entire plant and more persistent on the branches, where they may be as

much as 2 or occasionally 3 mm. long. The largest single plant of *Gaultheria* seen by me in Mexico was one of *G. hirtiflora*. This particular specimen (*Camp 2664*) was growing in the open on the middle slopes of Zempoaltepetl. It was a spreading, gracefully arched shrub 3 meters high and not less than 4 meters in diameter; its leaves deep-green above and glaucous below; at anthesis the rachis, pedicels and calyces were red and the corollas deep-pink to red; at maturity the calyx becomes purplish-black, covering the capsule. The fruit is sweet.

Although *G. hirtiflora* is reported from Guatemala (where it may even be common) I have seen specimens only from the states of Chiapas, Oaxaca, and Puebla in Mexico. Certain Guatemalan specimens with shorter, less dense pubescence and longer leaves would seem to be extremes of *G. odorata*.

Perhaps a further reason for a certain amount of the confusion in regard to *G. odorata*, at least in our American herbaria, was the earlier attempt to include in it the following related but distinct species.

Gaultheria Conzattii Camp, sp. nov.

Frutex ad 0.2 m. altus, ramulis pubescentibus; folia ovalia vel rectangulo-ovata, 2.5–4 cm. longa, 1–2.5 cm. lata, basi subcordata vel rotundata, apice obtusa vel abrupto-acuminata, supra subglabra, subtus pubescentia, pilis sparsis ferruginis, margine minute serrata vel undulata, setosa; racemi terminales, 2–3.5 cm. longi, rachis et pedicelli (circ. 5–9 mm. longi) dense albido-puberuli et ± dense rubro- vel ferrugino-pilosi, minute glandulosi; calyx 5-lobus, lobis acutis vel acuminatis, circ. 2 mm. longis, albido-puberulis, apice sparse glanduloso-hirsutis; corolla urceolata (intense rosea), apice manifeste contracta, strigosa vel crispe pilosa, pilis minute glandulosis vel eglandulosis; stamina 10, circ. 4 mm. longa, filamentis basin versus dilatatis, dense pubescentibus, circ. 2.25 mm. longis, antheris circ. 1.75 mm. longis; ovarium depresso-globosum pubescens.

Gaultheria Conzattii is a low, spreading, subcaespitose shrub to 0.2 m. with villous branches; leaves elliptic to ovate or individually oblong, 2.5–4 cm. long (rarely 5 cm. on sprouts) and 1–2.5 cm. wide, apically obtuse or abruptly acuminate with a fairly prominent calloused tip, basally subcordate to rounded, the margin finely serrate or occasionally undulate, setose, the hairs sometimes lost by mid-winter, the upper surface glabrous except for an extremely minute puberulence along the veins and, in occasional individuals, set with coarse ferruginous hairs mainly on the veins or on a broad band along the margin, the lower surface with abundant coarse ferruginous hairs, persistent on the petioles and larger veins, occasionally deciduous on the blade by mid-winter, petioles about 2 mm. long; inflores-

cence minutely puberulent; racemes 2–3.5 cm. long, rachis villous, the hairs tipped with minute glands or apically clavate, or sometimes individually glandless; pedicels 5–9 mm. long at anthesis, their pubescence of similar character as that of the rachis; bracts linear-oblong to oval, 5–8 mm. long, minutely puberulent to glabrate, their margins ciliate and (except for the lowest) set with the long glandular hairs typical of the inflorescence; bracteoles linear, subulate, or rarely oblanceolate, puberulent and glandular-hirsute; calyx somewhat spreading at anthesis (when dry), its lobes triangular, acute to acuminate, about 2 mm. long, cut about two-thirds of the way to the receptacle, the lobes with ciliate margins, the cilia often tufted at the apex, generally with a few scattered gland-hairs near the apex; corolla deep-pink, about 6 mm. long, urceolate, manifestly contracted at the apex, its lobes ovate, about 0.7 mm. long, strigose or with crisped, often minutely glandular hairs 0.5–1 mm. long, puberulent outside and inside; stamens 10; anthers about 1.75 mm. long; filaments about 2.25 mm. long, basally somewhat enlarged, pubescent on the contracted portion; ovary depressed-globose; style tapering, included; mature fruit not seen.

MEXICO. Oaxaca: Cerro de San Felipe, upper slopes, *W. H. Camp 2416*, Dec. 29. 1936 (type, N. Y.); ibid. *Camp 2870;* ibid. 8–10,000 ft., *Pringle 4679;* ibid. 10,000 ft., *Charles L. Smith 206;* ibid. 3000 meters, *C. Conzatti and V. Gonzáles 407.*

It is a pleasure to dedicate this species to my friend Professor C. Conzatti who, for so many years, has lived in Oaxaca where, every day he has looked up at the top of this mountain and in this, the twilight of his life, recalls days spent on its summit with Pringle and other collectors.

Closely related to *G. Conzattii* and distinct from it only by varietal rank is the following:

GAULTHERIA CONZATTII var. **mijorum** Camp, var. nov.

A speciei rachidibus et pedicellis eglandulosis, calyce subpubescente, margine ciliato differt.

Gaultheria Conzattii var. *mijorum*,[1] like the species with which I have related it, is a subcaespitose shrub, seldom or rarely exceeding 0.2 m. in height and apparently propagating by runners. Like other members of the genus when studied in the field, it proves to be variable, but the crisped, *completely nonglandular hairs* of the inflorescence, at first purplish-

[1] Named for the Mije tribe who inhabit this region and who still carry on their ancient sacrificial rites at an altar just a few meters from the place of collection of the type. For a further account and map see Jour. N. Y. Bot. Gard. **38:** 129–144, 153–170. 1937.

red but later ferruginous, are characteristic. They may be either scattered or dense. The leaves vary from ovate to oval, are 1–4.5 cm. long and fairly coriaceous when completely mature, subglabrous in the type collection, but scattered punctations on the lower surface and along the margin indicate a pubescence much like the species but apparently more completely deciduous, apically generally acute, but occasionally obtuse (particularly on abnormally dwarfed plants), basally rounded, subtruncate, or on the more robust plants subcordate; petioles 1–2 mm. long; racemes terminal or in the upper several nodes, 1–2.5 cm. long; or on extreme plants reduced to a single flower in the axils of the upper several leaves; rachis and pedicels minutely puberulent with white hairs and also bearing loosely set, crisped, nonglandular hairs up to 2 mm. long, the branches similarly clothed for several seasons; bracts glabrous except for the ciliate margin and the marginal gland-hairs (these confined to the upper several bracts); bracteoles much as in the species except that the hairs are apparently eglandular; calyx red, externally glabrous except for a finely ciliate margin, the cilations sometimes tufted at the tips of the lobes, the lobes lanceolate acute, about 2.5 mm. long at anthesis; calyx nearly covering the capsule at maturity, subcarnose and purple-black; corolla pink, urceolate, 6–7 mm. long, pubescent, the hairs on occasional flowers apically enlarged and clavate; capsules finely pubescent, becoming purplish at maturity, about 4 mm. high and 5–6 mm. broad.

MEXICO. Oaxaca: Zempoaltepetl, top of the mountain, *W. H. Camp 2659*, Sheet I, Feb. 19–27, 1937 (type, N. Y.).

The extreme forms (as *Camp 2659*, Sheet II, pars, in Herb. N. Y. Bot. Gard.) with their small, nearly oval (occasional suborbicular) leaves less than 2 cm. long, might be thought as distinct "species" were forms not found connecting them with more typical plants. These unusual plants, in general, are the result of aerial growth at the tips of long, fast-growing, rhizomatous branches.

Gaultheria Conzattii may be distinguished (*ex descr.*) from the recently described Oaxacan species *G. Cummingii* Sleumer at least by its subcordate or rounded leaf bases. In this connection it is to be mentioned that in his notes (Notizbl. **12:** 125. 1934) Sleumer compares his species with "*G. parviflora*" Small. Judging only by the description, this is an error for *G. parvifolia* Small. *G. Conzattii* may further be easily distinguished (*ex descr.*) from the recently described *G. Schiedeana* Sleumer at least by its much shorter leaves, these being only one-half as long as in *G. Schiedeana*. Although Sleumer does not indicate the state of collection, the locality listed (ibid. **12:** 128) would seem to indicate that the type (and only known

specimen) of *G. Schiedeana* came from Vera Cruz. A sufficient quantity of plants of *G. Conzattii* (numbering into the hundreds) have been studied in the field to convince the writer that there are no intergrades between it and the two species mentioned above.

One character is impressive as one studies the specimens of *G. Conzattii*. Here the glands on the tips of the hairs which clothe the inflorescence (an important feature in the ODORATAE) are reduced in size to little more than enlargements of the tip of the hair, or sometimes, absent. The species typically seems to be confined to El Cerro de San Felipe, near the city of Oaxaca. However, on Zempoaltepetl, about 80 kilometers to the east and the highest mountain in the state, it reappears in a form so like the species that it deserves no more than varietal rank. There are, perhaps, some workers who might segregate these as distinct species, but careful study in the field of both the species and its variety lead me to the conclusion that this newly described species with its variety is on the transition between those groups of species which have either glandular or nonglandular trichomes on their inflorescences.

GAULTHERIA PARVIFOLIA Small.

This species would seem to be closely related to the above species and its variety, for it too is apparently a low subcaespitose shrub, but its much narrower, glabrous leaves (I am unable to find more than a few punctations on the base of the mid-vein indicating the one-time presence of any sort of pubescence on the type—*Galeotti 1848*) would seem to be sufficient to separate these forms.

GAULTHERIA DOMINGENSIS Urban and G. SPHAGNICOLA Rich.

In connection with the general problem of the origin and dispersal of this last group of species, it might be mentioned that *G. domingensis* of the Caribbean region is similar to *G. Conzattii* var. *mijorum*, matching it in almost every respect, even to propagating by runners, as *Turckheim 3152* from Santo Domingo would indicate, but differs in having a relatively much larger calyx, a striking feature of this species.

Continuing on around to the Lesser Antilles we come to Guadeloupe which is supposed to be the northernmost limit of *G. sphagnicola*, differing from *G. domingensis* in having a glabrous corolla. I have seen material from Guadeloupe in which the corolla is glabrous, but more recent collections there by H. Stehlé include specimens of which the corollas have some pubescence. These plants are more robust and have larger corollas as well as slightly different leaves, linking them more closely to *G. domingensis* than to *G. sphagnicola*.

It would seem that *G. Conzattii* and its variety *mijorum* is related to *G. domingensis* and its derived species *G. sphagnicola* and that all of them are parts of and derived from that once remarkable distribution of Tertiary floras which extended from southern Mexico across the now almost completely submerged mountain ranges of ancient Antillia[2] and of which we now have left only marginal remnants in the West Indies, southern Mexico, Central America, and northern South America.

In the group of species derived from the more typical ODORATAE the following may be described as new:

Gaultheria tacanensis Camp, sp. nov. Frutex 0.6 m. altus, ramulis glabrescentibus, punctatis (junioribus pubescentibus?); folia ovalia vel rectangulo-ovata, basi subcordata vel rotundata, apice abrupto-acuminata, supra glabra, subtus glabra dense punctata (junioribus pubescenta?), 2.5–5 cm. longa, 1.5–2.5 cm. lata, margine minute serrata; racemi terminales, 4–6 cm. longi; rachis et pedicelli (circ. 4–5 mm. longi) dense albido-puberuli et dense ferrugino-pilosi, eglandulosi; calyx alte 5-lobus, lobis acuminatis circ. 2.5 mm. longis, crispe ferrugino-pilosis; corolla urceolata (rosea), apice manifeste contracta, crispe ferrugino-pilosula, eglandulosa, 5–6 mm. longa; stamina 10, filamentis basin versus dilatatis dense pubescentibus, 2.5 mm. longis, antheris quadricornutulis circ. 1.5 mm. longis; ovarium depresso-globosum pubescens.

Gaultheria tacanensis is apparently a strict to somewhat spreading shrub about 0.6 m. high with punctate, glabrous branches (the punctations indicating an early-deciduous pubescence); leaves elliptic to oblong, basally subcordate or rounded, apically abruptly acuminate to a minute calloused tip, glabrous above, glabrous but densely punctate below (the punctations being the bases of early-deciduous hairs), 2.5–5 cm. long and 1.5–2.5 cm. wide, minutely serrate, the serrations punctate tipped (the punctations being the bases of early-deciduous hairs); petioles thick, 2.4 mm. long; racemes generally several (?) from the uppermost nodes, 4–6 cm. long, many-flowered; rachis and pedicels (about 4–5 mm. long) with a dense minute puberulence and somewhat abundantly ferruginous-villous, eglandular; bracts linear-oblong, 7–10 mm. long, mostly glabrous except for marginal cilia; bracteoles subulate, minutely ciliate and sparsely villous; calyx deeply 5-lobed, cut almost to the receptacle, the lobes lanceolate or narrowly triangular, acuminate, spreading or reflexed at anthesis (when dry), about 2.5 mm. long, abundantly set with crisped, eglandular, ferruginous hairs; calyx at maturity becoming purple-black, its lobes thin and mostly spreading (when dry), scarcely covering the capsule; corolla pink, 5–6 mm. long, urceolate, manifestly contracted at the apex, its lobes ovate, 0.6–0.7 mm. long, covered with crisped, eglandular, ferruginous hairs; stamens 10; filaments about 2.5 mm. long, basally some-

[2] A term used here to indicate that much warped land-mass with its great series of mountain ranges which once extended across the Caribbean area.

what dilated, densely pubescent, particularly in the contracted part; anthers about 1.6 mm. long; ovary depressed-globose, pubescent; mature capsule depressed, 2–2.5 mm. high and 4–5 mm. broad with broad reddish lines on the outer (ventral) carpel walls.

MEXICO. Chiapas: Volcan Tacana, 10,000 ft. elev. *T. MacDougall* (without number), Jan. 16, 1938 (type, N. Y.).

This species, with no near relatives, but seemingly allied to *G. parvifolia* Small, may be easily distinguished from it by its somewhat more deeply cut and loosely villous calyx lobes. Since the type locality is on the boundary between Mexico and Guatemala[3] it seemed desirable to ascertain the exact location of the collection on the mountain, in spite of the fact that the specimen was labeled as having been collected in Chiapas. Mr. MacDougall informs me that, although he ascended from the Mexican side, at the 10,000 ft. elevation, the trail swings close to what he estimates is the boundary, that the species was seen on both sides of the trail, and it is possible that the plant from which the type was collected may have come from either side of the line. For this reason, it seems reasonable to record *Gaultheria tacanensis* from both Mexico and Guatemala.

GAULTHERIA GLANDULIFERA Small, N. Am. Flora **29:** 78. 1914.

Gaultheria poasana Sleumer, Notizbl. **12:** 127. 1934.

With the type specimen of *G. glandulifera* (COSTA RICA. Prov. Alajuela: Volcan Poas, alt. 2500 m., *J. D. Smith 6639*, M. Mart. 1896). and excellent material of the type collection of *G. poasana* (ibid, alt. 2600 m., *J. D. Smith 6631* M. Mart. 1896) both before me, I am unable to discover any specific difference between them, the differential characters pointed out by Sleumer being only those which one might expect on separate individuals of the same species growing at slightly different altitudes and in somewhat different habitats on the same mountain.

GAULTHERIA COSTARICENSIS (Donn. Smith) Small.

Closely matching the type of this species is the following collection: PANAMA. Forest of Cerro de Lino, above El Boquete, Chiriqui, altitude 1300 to 1560 meters, *H. Pittier 3032*, March 5, 1911. The range of the species is thus enlarged from Costa Rica to Panama.

[3] Although, on most maps, Volcan Tacana is placed in Guatemala, a more recent 1:500,000 scale edition [Estados Unidos Mexicanos. Secretaria de Agricultura y Fomento, Direccion de Estuidos Geograficos y Climatologicos. Hoja "TAPACHULA" (15°–91° 30′). Edición 1932] places the mountain on the international boundary approximately 30 kilometers NNE of Tapachula, Chiapas, with an elevation of 4000 meters.

PERNETTYA

Having a small series of numbers of *Pernettya* to identify, I attempted to make use of the recent monograph of this genus by Sleumer (Notizbl. **12**: 626–655. 1935) but found it inadequate for the specimens at hand. The material was evidently not conspecific and since Sleumer admitted but one species of the genus in Mexico, it was thought best to examine the Mexican material available.

One important factor in a study of this genus is its distribution. Specimens are rarely found below 6000 ft. elevation, reaching their maximum abundance between 8–10,000 feet. They are thus limited to the higher mountains (mainly the slopes of isolated peaks), a potent factor in the development of local endemism. The following treatment of the genus *Pernettya* in Mexico therefore represents my ideas concerning the distribution and speciation of this genus, based to a certain extent on field studies as well as on specimens not available to Sleumer during his revision.

PERNETTYA CILIATA (Cham. & Schlecht.) Small.

Under this species Sleumer has placed all the Mexican material of the genus. In his notes he mentions that the type (*Schiede 268* from the slopes of Orizaba, which I have not seen) is closely similar to *P. Pentlandii* of South America (*P. prostrata* var. *Pentlandii* (DC.) Sleumer, a combination with which I am not in full accord). This statement is further corroboration with my opinion that, if the specific lines are carefully drawn in strict accord with the type concept, *P. ciliata* is not particularly widespread in Mexico.

Specimens from the region around Orizaba closely fit the original description (Linnaea **5**: 126. 1830). Typically their branches are loosely setose; the leaves ovate-lanceolate and glabrous except for a few hairs on the mid-rib, the margins serrate, the serrations stipitate-glandular or occasionally with a few setae. The hairs on the pedicels are crisped and the bracts and sepals are glabrous except for the finely ciliate margins. The corollas and other floral parts, while differing in this from others of the more closely related species, are scarcely diagnostic.

MEXICO. Vera Cruz: "Pied d'Orizaba," *Galeotti 1828;* Orizaba, *Müller* without number in "1855";[4] *Müller 1424*, Aug. 1853;[5] "Malpays

[4] The date on the label is in error. Müller disappeared late in 1853 or early in 1854. 1855 is the year in which Schlumberger distributed the Müller specimens.

[5] This is a transposed label reading "*Arbutus xalapensis* HBK." The number is therefore probably incorrect. Although without locality data I have not hesitated to place the collection in the state of Vera Cruz (and probably near Orizaba) for Müller was known to have collected mainly between Vera Cruz and Orizaba.

de la Joya," *Schiede 171*. Hidalgo: Pine forests near Trinidad Iron Works, *Pringle 8962;* Sierra de Pachuca, *Pringle 11011*.

The specimens cited under *Schiede 171* and *Pringle 8962*, although apparently more robust and with a few of the basal leaves tending to be obovate, have the pubescence of the typical material on Orizaba. The material from Orizaba almost exactly matches the figure and description of *Arbutus pilosa* Graham (*P. pilosa* Don), in Bot. Mag. pl. *3177*.

Pernettya hirsuta (Mart. & Gal.) Camp, Comb. nov.

Gaultheria hirsuta Mart. & Gal. Bull. Acad. Brux. **9:** 540. 1842.

This species, ignored by the recent writers on the Ericaceae either under *Pernettya* or *Gaultheria*, is closely related to the foregoing but may be distinguished from it by the following features:

Branches densely setose; leaves (their margins serrate and completely setose) narrower and basally cuneate, their lower surfaces abundantly setose, the hairs not being limited to the mid-vein as in the preceding.

MEXICO. Oaxaca: "Sierra Pelado," 7000 ft., *Galeotti 1817*, Nov–April, 1840 (cotype of *G. hirsuta*). Vera Cruz(?): *Müller 1499*, August, 1853, without locality (see footnote #5).

It is unfortunate that I have been unable to study additional material of the type collection of this species, some of which came from the Cerro de San Felipe, just north of Oaxaca, but the description and specimen available match so exactly that I do not hesitate to connect our specimen with it. It is further unfortunate that no exact locality can be assigned to *Müller 1499*, cited above. However, it is so different in aspect from the others of his collections cited under a previous species, that the present writer feels certain that it is distinct from them. This and the foregoing species will be further discussed under a later note in this paper.

PERNETTYA BUXIFOLIA Mart. & Gal.

In regard to this species it is interesting to note that Martens and Galeotti recognized the genus *Pernettya*, describing a single species ("*Pernettia buxifolia*," Bull. Acad. Brux. **9:** 538. 1842); that they knew and differentiated the species *ciliata* and *hirsuta*, but on subsequent pages placed them in the genus *Gaultheria* (*loc. cit.* **9:** 539, 540). Here again, although I have not seen the type, the description is reasonably clear and the species may be distinguished from the preceding two by the following characters:

Entire plant, except for an almost microscopic puberulence on the branches, completely glabrous; leaves narrowly elliptic or sometimes linear, with the marginal setae completely absent and replaced by short glands; the pedicellary bracts apparently more reduced and the pedicels

relatively more elongate than in the preceding species. The type apparently was collected in the state of Hidalgo.

MEXICO. Est. Mexico: On Popocatepetl, *Rose and Hay 6047*. Federal District: Serrania de Ajusco, 10,000 ft., *Pringle 6304*.

Thus, with the valid names which have been assigned to Mexican species linked with describable entities and some of the material as yet neither disposed of nor assigned to them, it becomes necessary to describe the following new species.

Pernettya mexicana Camp, sp. nov.

Frutiusculus erectus ad 0.3 m. altus, ramis strigosis; folia angusto-elliptica vel linearia 1.5–2.5 cm. long, 3–6 mm. lata, brevissime petiolata, apice acuta vel obtusa, basi acuta vel subcuneata, subcoriacea, glabra, supra nitida, subtus pallida, margine serrulata (serraturis subacutis minute glandulosis); flores axillares solitarii ad summos ramulorum digesti, pedicellis sparse et crispe pilosis circ. 4–7 mm. longis, bracteae glabrae margine ciliatae; corolla cylindrico-urceolata, alba vel rosea, glabra, circ. 5.5 mm. longa et 4 mm. diam., apice breviter 5-lobata; sepala lanceolata acuminata, circ. 3 mm. longa, glabra, margine ciliata basin glandulosa; stamina 10, 3.5–4.5 mm. longa, antheris breviter 4-aristatis, filamentis glabris basi dilatatis subcarnosis; ovarium elongato-globosum, glabrum, stylo glabro; bacca purpureo-nigrescens.

The strigose branches and narrow, completely glabrous leaves of *P. mexicana* are diagnostic. In this species—and its close relatives—the setae on the leaf-margins are completely absent, being replaced with thickened gland-hairs only 0.15–0.25 mm. long. These marginal glands are homologous with and similar to those on the margins of the sepals—in this species apparently confined to the lower part of these organs.

MEXICO. Oaxaca: Top of Zempoaltepetl, *W. H. Camp 2652*, Feb. 19–27, 1937 (type, N. Y.); Cerro de San Felipe, *Camp 2604;* ibid., "Sierra" de San Felipe, *Pringle 4643*. Puebla: Rio Frio, *Lyonnet 208*. Mexico: Crucero Agua Blanca, *Hinton 4927, 8325*. Michoacan: Mountains near Patzcuaro, *Pringle 4115*.

Pernettya obovata Camp, sp. nov.

Frutex erectus plus quam 0.3 m. altus, ramis sparse strigosis; folia caulis principalis late cuneata, ramorum floriferum anguste ovalia vel cuneata, glabra, supra nitida, subtus pallida, margine serrulata (serraturis minute glandulosis), petiolo 1–2 mm. longo; rami terminales et laterales flores 8–15 gerentes; flores axillares solitarii, pedicellis crispe pilosis circ. 9–13 mm. longis, bractea glabra margine ciliata et glandulosa; corolla urceolata, glabra, circ. 5 mm. longa et 4 mm. diam., apice breviter 5-lobata; sepala lanceolata acuminata circ. 2.5 mm. longa, glabra, margine ciliata, glandulosa; stamina

10, circ. 3 mm. longa, antheris breviter (0.5 mm.) 4-aristatis, filamentis glabris basi dilatatis; ovarium globosum, glabrum, stylo glabro.

P. obovata is a shrub, coarse for the genus as it occurs in Mexico. Its broader, cuneate, heteromorphic leaves, floriferous branches, glandular bracts and markedly glandular sepals serve to separate it from the preceding.

MEXICO. Oaxaca: Cumbre de Huehuetlán, Distrito de Teotitlan, *C. Conzatti 4112*, May 22, 1921 (type, N. Y.).

Pernettya Tomasii Camp, sp. nov.

Frutex erectus, ramis strigosis; folia elliptica 1.5–2.5 cm. longa, 0.7–1 cm. lata, petiolo 1–2 mm. longo, apice acuta vel obtusa, basi obtusa, subcoriacea, supra glabra et nitida, subtus pallida (costa sparse hirsuta), margine serrulata (serraturis minute glandulosis); flores axillares solitarii, pedicellis circ. 2 mm. longis glandulo-pubescentibus, multibracteatis, bractea glabra margine subciliata; corolla cylindro-urceolata, glabra, circ. 6.5 mm. longa et 4 mm. diam., apice 5-lobata (lobis 1.0–1.5 mm. longis); sepala lanceolata circ. 3.5 mm. longa, margine subciliata et subglandulosa; stamina 10, circ. 3.5 mm. longa, antheris breviter 4-aristatis, thecis divergentibus, basi submucronulatis, filamentis glabris basi dilatatis; ovarium globosum, stylo glabro.

MEXICO. Chiapas: Volcan Tacana, alt. 8–9000 ft., *T. MacDougall* (without number) Jan. 15, 1938 (type, N. Y.); ibid. alt, 8,000 ft. (also at 12,000 ft.[6]), *T. MacDougall*, Jan. 15, 1938.

P. Tomasii, among the Mexican species of the genus, stands unique in having relatively short pedicels at anthesis, the flowers appearing almost sessile. Its nearest relative (and from which it probably is a derivative) is *P. coriacea* Klotzsch of Costa Rica and Panama. It may be distinguished from this last by its thinner leaves, divergent and mucronulate anther sacs, and its shorter pedicels. In *P. Tomasii* the pedicels are about 2 mm. long at anthesis and 3–5 mm. long in fruit, whereas in *P. coriacea* they are 5–8 mm. long at anthesis and 6–12 mm. long in fruit. It may easily be distinguished from the broad-leaved forms of *P. ciliata* by the strigose type of pubescence on its branches. The species is named in honor of the collector of the type, known to our mutual Mexican acquaintances as Don Tomás.

KEY TO THE MEXICAN SPECIES OF PERNETTYA

Flowers subsessile, the pedicels obscured by bracts at anthesis.....*P. Tomasii.*
Flowers manifestly pedicellate, the pedicels not obscured by bracts at anthesis.
Branches obscurely puberulent.....*P. buxifolia.*

[6] See footnote #3 and discussion under *Gaultheria tacanensis*. Its presence at this altitude would seem to indicate that the plant also occurs in Guatemala.

Branches strigose or setose.
Branches setose; leaves hirsute below, at least along the mid-vein.
Leaves sparsely hirsute, the hairs only on the mid-vein below, margin occasionally setose ..... *P. ciliata.*
Leaves abundantly hirsute below, margin completely setose..... *P. hirsuta.*
Branches strigose; leaves glabrous.
Leaves essentially isomorphic on the same plant, narrowly elliptic to linear..... ..... *P. mexicana.*
Leaves heteromorphic, broadly cuneate on the main stem and narrowly oval to cuneate on the flowering branches..... *P. obovata.*

A NEW HYBRID

A most puzzling form collected near Oaxaca and not referable either to *Gaultheria* or *Pernettya* may be treated as follows:

X Gaulthettya Camp, (*Gaultheria* × *Pernettya*) hybr. gen. nov.

Frutex parvus. Folia alterna coriacea. Inflorescentiae axillares, bracteosae, uniflorae. Pedicelli circ. 10-bracteati, bracteis coriaceis persistentibus. Calyx 5-lobus. Corolla urceolata, apice manifeste contracta, minute lobata. Stamina 10 receptaculo inserta. Filamenta libra, elongata, basin dilatata et carnosa, apice pubescentia. Antherae dorsifixae; thecis 4-aristatis. Discus 10-cornutulus. Ovarium superum, globosum, 5-loculare. Stylus teres, elongatus, inclusus.

X Gaulthettya oaxacana Camp, hyb. sp. nov. (*Gaultheria Conzattii* Camp × *Pernettya mexicana* Camp).

Frutex subcaespitosus ad 0.2 m. altus, ramis dense setosis; folia oblongo-elliptica circ. 2.5 cm. longa et 1 cm. lata, apice acuta, basi rotundata, subcoriacea, supra nitida sparse setosa, subtus pallida ± dense setosa, margine minute serrulata, setosa, petiolo 1–2 mm. longo; flores axillares solitarii ad summos ramulorum digesti, pedicellis dense et crispe pilosis 5–8 mm. longis, bractea sparse villosa, margine glandulo-setosa; corolla globo-urceolata, rosea, sparse hirsuta, circ. 7 mm. longa et 6 mm. diam., apice contracta et 5-lobata, lobis circ. 2.5 mm. longis; calyx 5-lobus, lobis circ. 3 mm. longis, glabris, margine ciliatis; stamina 10, filamentis circ. 2.5 mm. longis, basi dilatatis et carnosis, apice sparse pubescentibus, antheris circ. 1.5 mm. longis; ovarium globosum puberulum; stylus glaber.

The specimens were taken from plants just coming into flower and fairly abundant over an area not less than 10 meters in diameter. The plants appeared to be a clone. The inflorescence characters, as well as the shape and texture of the pedicellary bracts, would closely link them with *Pernettya*, whereas the shape of the corolla, structure of the calyx, pubescence of the staminal filaments, as well as the foliage and general aspect would link them with *Gaultheria*. The finding of occasional abnormal corollas on the type collection would seem to add further credence to the view of its hybrid origin.

MEXICO. Oaxaca: Cerro de San Felipe, upper slopes, *W. H. Camp 2414*, Dec. 29, 1936 (type, hybrid gen. and sp., N. Y.).

The problem of the relationship and origin of the *Gaultheria—Pernettya* complex is again opened up by the finding of this hybrid material. If the two parents had not been growing on the same mountain, and on the same slope nearby, there would have been some hesitancy on the part of the writer in placing it in a hybrid category. Otherwise, it would have seemed sufficiently distinct from either to be described as a new genus.

In Mexico the species of *Gaultheria* known to the writer, although belonging to several species groups, have a certain amount of pubescence on the staminal filaments, their inflorescences are racemose and the calyces are obviously synsepalous. On the other hand, the species of *Pernettya* have glabrous filaments, each branch of the multibracteate inflorescence is reduced to a single flower and the sepals are free nearly to the base and, when carefully examined, are seen to be basally imbricate. In the field, the aspect of the plants is adequate to separate the genera.

However, other features must be considered when attempting to sort the material from South America and the Australian Region. Possibly *Pernettya* could be united with *Gaultheria* but it is more probable that future critical study in this group will lead to the segregation of several additional genera.

In addition to the general interest in this obvious hybrid, it is further important in the interpretation of several of the species of *Pernettya* in Mexico. The bulk of the material of this genus may be characterized as having strigose hairs on the branches, whereas in *Gaultheria*, when a coarse pubescence is present, it is generally of a setose nature (although the hairs are often tipped with glands). However, in two species of *Pernettya*, the branches are setose rather than strigose. These two species are *Pernettya ciliata* and *P. hirsuta*. Careful examination of the material available of both would lead the present writer to the view that it is highly probable that they are the result either of a backcross between such a hybrid as *X Gaulthettya oaxacana* and the *Pernettya* parent, or genetic segration from the hybrid itself.

Of the two, *P. ciliata* seems to be by far the most stabilized and well on its way to becoming established as a species. On the contrary, it is altogether possible that *P. hirsuta*, while a distinct entity, is not a "good species" but serves only as the receptacle into which certain of the extreme pernettyoid segregates can be placed for the sake of present nomenclatorial convenience. The exact status of such forms will never be completely understood until we know the genetics of such hybrids and their segregates.

In conclusion, it may be stated that I am absolutely opposed to maintaining the Mexican species of *Pernettya* under *P. ciliata*, first, because the bulk of the material is not conspecific with it and, second, that this species, in all probability, is not a direct phylogenetic derivative from within *Pernettya*, but carries a certain amount of *Gaultheria* heredity, acquired subsequent to the segregation of the genus *Pernettya* from the ancestral gaultherioid stock.

THE NEW YORK BOTANICAL GARDEN

Additions to Florida Fungi—I

WILLIAM A. MURRILL

(WITH THREE FIGURES)

This series will include new species and notes on interesting fungi that are picked up from time to time in Florida. Numbers cited refer to collections in the herbarium of the Florida Agricultural Experiment Station, at Gainesville. Already, about two hundred Florida novelties have either been published or are soon to appear in this and other periodicals. The field is a fertile one, largely unworked.

Agaricus Rhoadsii sp. nov.

Pileo truncato-conico ad expanso, 6.5 cm. lato, fibrilloso-squamuloso, pallide vinoso, disco castaneo; sporis 5×3 μ, stipite albo, bulboso, 8×0.6–1 cm.; annulo amplo, persistente.

Pileus truncate-conic to expanded, solitary, about 6.5 cm. broad; surface dry, finely fibrillose-squamulose, pale dilute-vinosous, castaneous on the flat disk; margin white, sterile, widely projecting, appendiculate and fringed; context firm, white, unchanging, odorless; lamellae free, narrow, inserted, crowded, entire, whitish to dull-pink and finally purplish-brown; spores ovoid, smooth, 1-guttulate, purplish-brown, about 5×3 μ; cystidia none; stipe tapering upward, smooth, white, glabrous, bulbous, 8×0.6–1 cm.; veil very large, membranous, fixed, apical, persistent, double, smooth and white above, decorated with isabelline scales below.

Type collected by A. S. Rhoads and W. A. Murrill under oaks in a high hammock at Gainesville, Fla., Sept. 7, 1938 (*F 18117*). The color is very unusual for the genus, being pale-purple while the flesh is still firm and milk-white. *Lepiota* was at first suggested but the truncate cap was more like *Agaricus*. I know of no other species that approaches it.

Agaricus Weberianus sp. nov.

Pileo convexo-expanso, 7.5 cm. lato, roseo-avellaneo, disco badio, squamuloso; lamellis remotis, sporis ellipsoideis, 5×3 μ; stipite albo, 8×1 cm., annulo amplo, albo, persistente.

Pileus convex to expanded, solitary, 7.5 cm. broad; surface dry, rosy-avellaneous, badious on the smooth broad convex disk, decorated with small flat imbricate scales; margin very narrowly sterile, even, entire to slightly undulate; context thick at the center, white, unchanging, sweet, odorless; lamellae free, remote, narrow, crowded, inserted, entire, pallid to purplish-brown; spores ellipsoid, smooth, purplish-brown, 1-guttulate, about 5×3 μ; stipe equal above the slightly enlarged base, smooth, white, glabrous, 8×1 cm.; veil double, very ample, very thin, white, fixed 1 cm. from the apex, with small isabelline scales on the lower side, hanging 2 cm. long like a wet skirt.

Type collected by W. A. Murrill on a shaded trash pile in Gainesville, Fla., Sept. 9, 1938 (*F 18131*). Suggesting *A. subrufescens* Peck but solitary and having much smaller spores. Dedicated to Dr. George F. Weber, who has taken an active interest in building up our mycological collection.

Pluteus nigrolineatus sp. nov.

Pileo convexo-subexpanso, 2.5 cm. lato, griseo, nigro-reticulato; sporis ovoideis, 8×6 μ, stipite albo, 4×0.4 cm.

Pileus convex to subexpanded, solitary, 2–2.5 cm. broad; surface dry, shining, griseous, with distinct reticulating black lines, margin splitting with age; context very thin, white, odorless; lamellae free, very broad and rounded, inserted, crowded, entire, white to pink; spores ovoid, strongly tapering below, smooth, pink, usually 1-guttulate, about 8×6 μ; cystidia fusoid, truncate, hyaline, about 45×15 μ; stipe subequal, smooth, white, glabrous, shining, the base slightly enlarged, black-lined, partly white and partly dark-blue, 4×0.4 cm.

Type collected by W. A. Murrill on an oak log in Gainesville, Fla., Sept. 8, 1938 (*F 18103*). Suggesting *P. fibrillosus* Murr. but differing in color and microscopic characters. Reticulate as in *P. admirabilis* Peck but having the stipe black-lined at the base.

Pluteus Rhoadsii sp. nov.

Pileo hemisphaerico ad subexpanso, 3–4 cm. lato, scabro, striato, umbrino; sporis subglobosis, 5 μ, stipite albo, glabro, 5–6×0.2–0.4 cm.

Pileus hemispheric to subexpanded, densely gregarious to subcespitose, about 3–4 cm. broad; surface dry, scabrous or hispid, checked at the center, very finely striate, umbrinous, at times fulvous on the disk; margin entire, rimose with age; context firm, white, unchanging, odorless, sweet and nutty; lamellae free, rounded behind, arcuate, narrow, crowded, inserted, white, entire, thick; spores subglobose, smooth, uniguttulate, pink, about 5 μ; cystidia none; stipe enlarged and usually slightly bulbous below, smooth, white, glabrous, fistulose, umbrinous and finely tomentose at the base, about 5–6×0.2–0.4 cm.

Type collected by A. S. Rhoads and W. A. Murrill on a rotten oak log under oaks at the Tung-oil Mill, Alachua Co., Fla., Sept. 7, 1938 (*F 18101*). Suggesting *P. fibrillosus* Murrill, but densely gregarious and having smaller spores.

Venenarius Rhoadsii sp. nov.

Pileo convexo-subexpanso, 5–8 cm. lato, albo, spinuloso; sporis elongatis, 10×14 μ, stipite radicato, volva veloque evanescentibus.

Pileus convex to subexpanded, gregarious, 5–8 cm. broad; surface dry, white, cremeous on drying, decorated with long, pointed warts, especially on

the disk, margin entire, even; context white, unchanging, with strong odor of chloride of lime; lamellae adnexed with decurrent ridges, rather broad, medium distant, inserted, entire, white, becoming brown when dried; spores sausage-shaped, smooth, hyaline, about 10×4 μ; stipe white, floccose-squamose, cremeous when dry, about 5×1–1.5 cm., the root 5–10 cm. long, either elongate-fusiform or elongate-turbinate; veil white, breaking up into floccose fragments; volva soon disintegrating and mostly carried up on the cap.

Type collected by A. S. Rhoads under live-oak at Lake Rosa, Putnam Co., Fla., Sept. 8, 1938 (*F 18125*). Suggesting *V. solitariiformis* Murrill but having a strong odor of chloride of lime.

Armillaria Boryana (Mont.) Murrill, comb. nov.

Collybia Boryana Sacc. Syll. Fung. **5:** 240. 1887.

This tropical American species is frequent about Gainesville on oak logs and stumps, often appearing in quantity, but the presence of a veil was not noticed until Mr. Erdman West brought in a collection he made at Magnesia Springs, Fla., July 3, 1938 (*F 17344*). In young hymenophores about 1.5 cm. broad, the tough, white, membranous veil had just ruptured from the stipe, exposing the young gills in a polygonal area. Older hymenophores showed broad fragments of the veil attached to the margin, while in still older stages hardly a trace of the veil was left. At no time was an annulus present, the stipe being simply squamose where a ring might have been.

Appearing here in the same season with the above, also on the tops of hardwood logs in woods, is another interesting tropical species, *Armillaria alphitophylla* (Berk. & Curt.) Murr., described from the Bonin Islands and noted for its immense spores and cystidia. In some specimens the caps are as spotted as the skin of a leopard.

Lactaria subtestacea sp. nov.

Pileo convexo-depresso, 7 cm. lato, viscido, testaceo-ochraceo, piperato; lamellis ochroleucis, sporis globosis, tuberculatis, 6 μ; stipite glabro, ochroleuco 5×1.7–2 cm.

Pileus convex to slightly depressed, solitary, 7 cm. broad; surface viscid, indistinctly striate, not at all zonate, uniformly testaceous-ochraceous, shining, margin entire, concolorous; context pallid, opaque, unchanging, odorless, slowly distinctly acrid; lamellae adnate, medium broad, medium distant, 3–4-times inserted, entire, ochroleucous; latex white, unchanging; spores globose, distinctly tuberculate, hyaline, 1-guttulate, about 6 μ; stipe equal, uneven but not pitted, glabrous, pale rosy-ochroleucous, 5×1.7–2 cm.

Type collected by W. A. Murrill on the ground in a high hammock at

Gainesville, Fla., Sept. 21, 1938 (*F 18209*). An attractive species without near relatives and doubtless very rare.

Galactopus serifluus sp. nov.

Pileo convexo-subexpanso, umbilicato, 1.5 cm. lato, melleo, disco subnigro; lamellis adnatis, albis, sporis ovoideis, 3×2 μ, stipite 2×0.2 cm.

Pileus convex to subexpanded, umbilicate, gregarious, 1.5 cm. broad; surface smooth, glabrous, opaque, melleous, blackish at the center; margin incurved, even, entire; context rather thick, opaque, pallid, odorless, somewhat mawkish, bleeding watery drops when cut; lamellae adnate with a small decurrent tooth, medium distant, broad behind, inserted, entire, white, unchanging; spores ovoid, smooth, hyaline, 1-guttulate, about 3×2 μ; cystidia none; stipe equal, smooth, pallid and pruinose above, subconcolorous and subglabrous below, whitish-tomentose at the base, 2×0.2 cm.

Type collected by W. A. Murrill on a rotten magnolia log in a hammock at Gainesville, Fla., Sept. 14, 1938 (*F 18104*). An aberrant species with incurved margin like *Gymnopus* and bleeding from the context more than from other parts of the hymenophore. Dried specimens would be referred to *Gymnopus* without hesitation. *Galactopus rugosodiscus* (Peck) Murr. is probably its nearest relative.

Gymnopus albidus sp. nov.

Pileo convexo-expanso, 1.5–2 cm. lato, albo; lamellis sinuatis, albis, sporis 10×4 μ, stipite pellucido, 3×0.1–0.3 cm.

Pileus convex to plane or umbilicate, gregarious to subcespitose, 1.5 to 2 cm. broad; surface smooth, glabrous, uniformly white, margin even, entire; context thin, white, unchanging, odorless, mild; lamellae sinuate, rather crowded, broad, ventricose, inserted, entire, white, unchanging; spores pip-shaped, smooth, hyaline, granular, about 10×4 μ; cystidia none; stipe equal, smooth, glabrous, translucent, 3×0.1–0.3 cm.

Type collected by E. West and W. A. Murrill in soil at the base of a southern red cedar at Magnesia Springs, Fla., Sept. 17, 1938 (*F 18176*). A white species growing in soil and having a translucent stipe.

Gymnopus palmarum sp. nov.

Pileo hemisphaerico, 4–6 mm. lato, testaceo, farinaceo; lamellis albis, sporis 4–5×3 μ, stipite testaceo, 2×0.1–0.2 cm.

Pileus conic to hemispheric, not expanding, gregarious to cespitose, 4–6 mm. broad; surface dry, testaceous, finely fibrillose-tomentose; margin even, entire, sharply incurved when young; context thick at the center, thinning out toward the margin, pale yellowish, taste decidedly farinaceous; lamellae adnate, broad, inserted, distant, entire, white to discolored; spores ellipsoid,

smooth, hyaline, granular, 4–5×3 μ; cystidia few, hyaline, long, gradually tapering to a sharp point; stipe cartilaginous, equal or unequal, smooth, shining, glabrous, testaceous, hollow, about 2×0.1–0.2 cm.

Type collected by W. A. Murrill in soil about the base of a Washington palm in Gainesville, Fla., Sept. 7, 1938 (*F 18102*). A small species with hemispheric, testaceous cap and shining stipe. It has no near relatives.

Gyroporus umbrinisquamosus sp. nov.

Pileo convexo, 6 cm. lato, isabellino, umbrino-squamuloso, sapore grato; tubulis parvis, albidis, sporis albis, 9–11×4–5 μ; stipite praeclavato, 6×1.3–2 cm.

Pileus broadly convex, solitary, 6 cm. broad; surface dry, isabelline, with conspicuous umbrinous fibrillose squamules, margin entire, even; context about 5 mm. thick, white, unchanging, mild, odorless; tubes plane, depressed, about 5 mm. long, mouths minute, circular, not stuffed, white with a faint sulfur tint, unchanging; spores oblong-ellipsoid, obliquely apiculate, granular, smooth, hyaline, about 9–11×4–5 μ; stipe very clavate, hollow, pubescent, dull-rosy-isabelline above, umbrinous below, 6×1.3–2 cm.

Type collected by W. A. Murrill on the ground in turkey-oak woods at Gainesville, Fla., September 2, 1938 (*F 17417*). Suggesting *Tylopilus peralbidus* (Snell & Beard.) Murrill, but squamulose and not bitter.

Poria Rhoadsii sp. nov.

Late effuso, adnato, 6–12×2–4 cm., margine albo, fimbriato; tubulis flavis ad roseo-avellaneis, 3–5×0.3 mm., sporis hyalinis, 2×1 μ.

Widely effused, adnate, uneven, following the irregularities of the substratum in patches 2–4 cm. wide and 6–12 cm. long; margin narrow, thin, white, fimbriate, more or less evanescent; sterile zone back of extreme margin thicker and flavous, remaining flavous in dried specimens; context hardly apparent at maturity; tubes irregular, angular, quite firm, flavous within and without, 3–5 mm. long, about 3 to a mm., edges thick to thin, becoming dentate, changing from flavous to pale-roseous with age, distinctly rosy-avellaneous when dry, presenting a pleasing contrast to the younger flavous tubes; spores ellipsoid, smooth, hyaline, 2×1 μ; cystidia none.

Type collected by A. S. Rhoads and W. A. Murrill on a decorticated sweet-gum log in a high hammock north of Hunter's Station, Fla., Sept. 6, 1938 (*F 18132*). Also collected by West and Murrill on a decayed log at Gainesville, Fla., Sept. 16, 1932 (*F 9111*). A beautiful species, which I tried hard to connect with *P. vitellina* (Schw.) Cooke. The spores cited above fell on a glass slip under a bell-jar. They seem rather small. Others found floating about in section mounts were ellipsoid, smooth, hyaline,

1-guttulate, 8×4–5 μ. These seem much too large to be basidiospores of such a plant.

Inonotus ludovicianus melleus var. nov.

Pileo melleo, zonato, tubulis non constipatis, sporis 5×3 μ.

Pileus finely hispid-tomentose, slightly sulcate, melleous, concentrically banded with umbrinous-melleous zones about 1 cm. broad; context soft-corky, pallid to umbrinous, about 1 cm. thick; hymenium stramineous at the sterile border, avelaneous where the young tubes have formed, and umbrinous behind; tubes 2–3 mm. long, about 3 to a mm., angular, entire, not stuffed when young; spores ellipsoid, obliquely apiculate, granular, pale-ferruginous under the microscope, about 5×3 μ.

Type collected by West and Murrill on the base of a living laurel oak at Magnesia Springs, Fla., Sept. 17, 1938 (*F 18177*). A splendid variety, reaching 22×32 cm., honey-yellow banded with darker zones, the tubes not stuffed when young, and the spores somewhat smaller than in the typical form. The species no doubt causes considerable decay in oak trees.

GANODERMA CURTISII (Berk.) Murrill

Described from South Carolina in 1849 and known to occur from New York to Florida and Texas on living and dead trunks, stumps, or roots

Fig. 1. *Ganoderma Curtisii* (Berk.) Murrill ×$\frac{1}{6}$. Hymenophore on trunk of living ash at Gainesville, Fla. Photo by G. F. Weber.

of oak, sweet gum, maple and certain other deciduous trees. The accompaying illustration is from a photograph taken by Dr. G. F. Weber on livlng ash, an unusual host. I have observed the development of this particuiar specimen for some time. The species is very abundant about Gainesville, especially on oaks, and it undoubtedly does considerable damage.

Fig. 2. *Ganoderma sulcatum* Murrill $\times\frac{1}{4}$. Hymenophore on dead trunk of *Butia capitata* Becc. at Gainesville, Fla. Photo by G. F. Weber.

Those who have studied the rot describe it as very striking and distinct. There is much work yet to be done, however, before our knowledge of the species of *Ganoderma* and the injury caused by them is anything like complete.

Ganoderma sulcatum Murrill

Described from Florida in 1902 and known to occur there commonly on palmetto trunks and logs. In September, 1938, it was found at Gainesville on a small "*Cocos australis*" (*Butia capitata* Becc.), which had died in less than a year from transplating. The hymenophore measured 6×9 inches and was about three inches thick behind. The following notes on the decay are contributed by Dr. G. F. Weber, plant pathologist in the Florida Agricultural Experiment Station.

"The palm was dug and sectioned and it was found that the root sys-

tem and lower portion of the main trunk, although slightly discolored, was not infected by the fungus. A cross-section 18 inches up from the butt end (this cut being below the position of the sporophore) showed occasional mycelial infected pockets, mostly in the center of the trunk. Another section, just above the sporophore, showed elongated pockets from the center to the edge; the largest, lenticular in shape, 1×2 inches, and the smallest,

Fig. 3. Cross section of trunk of *Butia* showing decayed wood with mycelium of *G. sulcatum*. Photo by G. F. Weber.

elongate. Other sections toward the top of the plant showed that these pockets increased in number and size until they reached the growing point of the palm, which was in a putrescent condition. The lower extremities of the pockets in the wood were surrounded by dark chocolate-brown color, which apparently showed the advance of the fungus beyond which point no mycelium was found. The base of the leaf petioles showed an accumulation of mycelium next to the trunk. The fungus probably invaded the palm through the upper portion, which was suffering because of transplating operations, and was advancing toward the base. It probably did

not kill the palm but it is evident that it was a material factor in the disintegration and decay of the main trunk."

NEW COMBINATIONS

For those using Saccardo's nomenclature the following new combinations are made:

Galactopus serifluus = **Mycena seriflua**
Gymnopus albidus = **Collybia albida**
Gymnopus palmarum = **Collybia palmarum**
Gyroporus umbrinisquamosus = **Boletus umbrinisquamosus**
Venenarius Rhoadsii = **Amanita Rhoadsii**

HERB. FLA. AG. EXP. STATION
GAINESVILLE, FLORIDA

New Ferns from Bolivia and Peru[1]

WILLIAM R. MAXON AND C. V. MORTON

(WITH ONE FIGURE)

In the course of zoological field work in Bolivia in 1926, under the auspices of the American Museum of Natural History, Mr. G. H. H. Tate made a considerable botanical collection, which was turned over to the New York Botanical Garden. The ferns and fern allies (about 250 numbers) were subsequently sent to U.S. National Museum for identification. A considerable number of them are from comparatively low elevations and represent rather common or widely distributed species, but those from the higher mountains are of decided interest, since they include such rarities as *Cheilanthes andina* Hook., *Diplazium mapiriense* Rosenst., and *Lycopodium pendulinum* Hook., besides the new species herewith described. In addition, there are several critical forms in *Elaphoglossum*, *Polystichum*, and *Struthiopteris*, which, though apparently new, it seems inexpedient to describe at present in view of existing confusion within these genera.

There are included descriptions of a second new species of *Blechnum* collected in Bolivia by Prof. M. Cárdenas and a new *Polypodium* from Peru, the latter being represented in the Tate collection by a sterile specimen only.

Polypodium megalolepis Maxon & Morton, sp. nov.

§ *Lepicystis*, venatione *Goniophlebii*. Rhizoma rampans, paleis planis imbricatis castaneis concoloribus ovato-attenuatis magnis (usque ad 10 mm. longis) subpersistentibus laxe onustum. Folia pauca, remota, stipitibus tenuibus quam laminis plerumque paulum brevioribus; lamina oblonga vel deltoideo-ovata, usque ad 11 cm. longa et 6 cm. lata, profunde pinnatifida; laciniae 7-jugae, subaequales vel superiores infra apicem elongatum subabrupte reductae, lineares, late et longe decurrentes, dense opacae (marginibus conspicue callosis obtuse serrulatis), subtus subremote punctato-paleaceae, paleis minutis, rotundis vel maximis (1 mm. longis) late ovatis et abrupte attenuatis, castaneis, marginibus erosis pallidioribus; areolae obliquae, ellipticae, magnae, uniseriales, 8–12-jugae; sori 7–11-jugi, rotundi, 3–4 mm. diam., mediales, fere paginam inferam totam tegentes.

Epiphytic, the rhizome rampant, lightly attached at intervals, more than 30 cm. long, flattish in drying, 3–4 mm. broad (excluding scales), densely but loosely imbricate-paleaceous, the scales laxly oblique, ovate-attenuate, very large, 8–10 mm. long, 2–3 mm. broad, attached at sinus of deeply cordate base (basal lobes rounded and widely over-lapping, often elongate), lightly denticulate, plane, firm, castaneous, concolorous, nearly uniform in structure, not

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clathrate, the cells very small, variable in shape, irregularly oblong or linear, with outer and partition walls of similarly pale coloration, or those near point of attachment shorter, with thicker partition walls. Fronds few, conform, about 4 cm. apart, 14–18 cm. long, the stipe somewhat shorter than the blade, dull castaneous, 1 mm. thick, bisulcate ventrally, nearly naked; blades oblong to deltoid-ovate, 10–11 cm. long, 4–6 cm. broad, deeply pinnatifid, the rachis broadly alate, concealed; segments about 7 pairs, oblique-spreading, their width apart at middle, subequal or the upper ones reduced below the subconform elongate apex, linear, up to 4 cm. long and 7 mm. broad at middle, acuminate, broadly decurrent, the basal ones extending 1–1.5 cm. downward upon the stipe; veins oblique, 8–12 pairs, goniophlebioid, the single row of large elliptical areoles reaching three-fourths the distance to the margin, with a few excurrent branches; sori 7–11 pairs, superficial, medial, round, 3–4 mm. broad, adjacent, confluent at maturity, non-paraphysate, the sporangia very numerous. Leaf tissue rigidly thick-coriaceous, opaque, yellowish-green, the strongly cartilaginous margins bluntly serrulate; upper surface of segments naked; lower surface persistently punctate-paleaceous, the scales not contiguous, mostly roundish and about 0.5 mm. broad, the largest ones roundish-ovate and abruptly acuminate-attenuate, all the scales appressed, dark castaneous with pale erose margins.

Type in the U. S. National Herbarium, no. 604,470, collected in the Lucumayo Valley, Peru, June 18, 1915, by O. F. Cook and G. B. Gilbert (no. 1283).

Not only in general appearance but in technical characters *P. megalolepis* differs from previously described species too widely to require detailed comparison. The long-decurrent segments are an outstanding character; also the very large, laxly imbricate, concolorous rhizomes scales, these not at all reticulate or clathrate, but of fine nearly uniform cellular structure, the cells being minute and elongate with the outer walls colored like the thin partition walls.

This species is known also from Bolivia, from a sterile specimen (herb. N. Y. Botanical Garden) collected at Alaska Mine, alt. 4110 meters, March 1926, by G. H. H. Tate (no. 54).

Blechnum malacothrix Maxon & Morton, sp. nov.

Rhizoma ut videtur suberectum, ca. 1.5 mm. diam., paleis ovatis appressis fuscis crassis lucidis minutis praeditum. Folia plura, fasciculata, erecta, 10–25 cm. longa, stipitibus tenuibus quadrangularibus stramineis, laminas subaequantibus, tristelicis, glanduloso-pilosulis; lamina linearis, sursum attenuata, 5–14 cm. longa, usque ad 2.6 cm. lata, basi pinnata, sursum pinnatisecta, rhachi subdense glanduloso-pilosula; laciniae 12–20-jugae, infimae distantes, paulum reductae et reflexae, subauriculatae, superiores

anguste oblongae (maximae 12.5 mm. longae et 4.5 mm. latae), patentes, antrorse subfalcatae, apice rotundae, basi late adnatae, antice auriculatae, marginibus leviter callosis, scabridis; coenosori ca. 1 cm. longi et 2 mm. lati, crassi, indusio glabro, manifeste inframediali, angusto; parenchyma herbacea, utrinque dense glanduloso-pilosa.

Rhizome (incomplete) short, oblique, 1.5 mm. thick, appressed-paleaceous; scales narrowly ovate, deeply cordate, 0.5–0.8 mm. long, shining, blackish (central cells opaque, the basal ones irregularly hexagonal, the distal elongate, the marginal pale and translucent), bearing a few distant cilia. Fronds several, fasciculate, erect, 10–25 cm. long, the stipes tristelar, stramineous, quadrangular, very slender (about 0.5 mm. in diam.), 6.5–12 cm. long, sparsely paleaceous near base, rather densely glandular-pilosulous, the hairs 3- to 5-celled, up to 0.5 mm. long; blades linear, attenuate in apical half, pinnate at base, above pinnatisect nearly to the subcaudate apex; rachis densely glandular-pilose; pinnae 12–20 pairs, opposite or alternate, the lowest 8–12 mm. distant, slightly reduced, subreflexed, the middle ones narrowly oblong, up to 12.5 mm. long and 4.5 mm. wide, spreading almost horizontally, upwardly subfalcate, rounded at apex, broadly adnate, auriculate distally, the lower pinnae slightly auriculate basally also; margins lightly cartilaginous, scabrous; leaf tissue herbaceous, densely glandular-pilose on both surfaces; coenosori about 1 cm. long, 2 mm. wide, very thick, the indusia distinctly inframedial, distant about 0.5 mm. from the midrib, narrow, glabrous; sporangia very numerous; annulus 13-articulate; spores reniform, about 35 μ long, pale yellow.

Type in the New York Botanical Garden, collected at Okara, Cordillera Real, Bolivia, altitude 2250 meters, April 26–29, 1926, by G. H. H. Tate (no. 951). Duplicate in the U. S. National Herbarium.

The relationship of *B. malacothrix* is doubtless with *B. laevigatum* Cav., of which *B. distans* Presl is a synonym, as is probably also *B. Juergensii* Rosenst. The two differ as follows:

Blade linear; segments not more than 4.5 mm. wide, rounded at apex; stipe, rachis, costae, and leaf surface densely glandular-hairy; rhizome scales minute, the central portion blackish, opaque. *B. malacothrix.*

Blade triangular-lanceolate or lanceolate; segments 5–10 mm. wide, mucronate at apex; stipe, rachis, costae, and leaf surface sparsely glandular-hairy; rhizome scales larger, concolorous, brown, the cells all translucent . . . . . *B. laevigatum.*

Blechnum delicatum Maxon & Morton, sp. nov.

Rhizoma suberectum, ca. 2 mm. diam., paleis paucis deltoideo-lanceolatis acuminatis firmis fusco-castaneis brunneo-marginatis usque ad 1.5 mm. longis onustum. Folia plura, fasciculata, 9–15 cm. longa, stipitibus 1–5.5 cm. longis,

Fig. 1. *Polypodium megalolepis* Maxon & Morton.
The type specimen; about half natural size.

tenuibus, bistelicis, stramineis, glanduloso-pilosulis, basi paleas brunneas paucas majusculas ferentibus; lamina anguste linearis, 5–12 cm. longa, basi pinnata, supra subpinnatisecta, utrinque attenuata, apice elongato integro; rhachis ubique glanduloso-pilosula, epaleacea; laciniae 13–26-jugae, infimae subdistantes, rotundae, adnatae, superiores leviter conjunctae, late triangulares, usque ad 6 mm. longae, integrae, apice rotundo mucronulatae, costa subflexuosa obscura; venae paucae; coenosori usque ad 4 mm. longi, indusio glabro manifeste inframediali; parenchyma membranaceo-herbacea, supra subglabra, subtus minute glanduloso-pilosula.

Rhizome suberect, about 2 mm. thick, sparingly paleaceous, the scales triangular-lanceolate, acuminate, 1–1.5 mm. long, thick, opaque, very dark castaneous, the margins pale brown, translucent, bearing a few capillary teeth. Fronds fasciculate, numerous, ascending, 9–15 cm. long, the stipes subimbricate, 1–5.5 cm. long, about 0.5 mm. thick, bistelar, stramineous, terete, sulcate ventrally, glandular-pilosulous, sparingly paleaceous at base, the scales pale brown, translucent, otherwise like those of the rhizome; blades linear, 5–12 cm. long, 7–13 mm. broad, pinnate at very base, subpinnatisect upwardly, attenuate both ways, the apex elongate (1–1.5 cm.), entire; rachis glandular-pilosulous, devoid of scales; segments 13–26 pairs, the lower 1 to 3 pairs subdistant, rounded, 2.5–3 mm. long, 4–5 mm. broad, wholly adnate at base, the other segments all faintly joined, broadly triangular, up to 6 mm. long and 5 mm. wide, entire, rounded and slightly mucronate at apex, the costa very obscure, subflexuous; lateral veins about 4 pairs, the lower ones furcate; leaf tissue delicately herbaceous, nearly glabrous above, minutely glandular-pilosulous beneath; coenosori up to 4 mm. long and 2 mm. wide, the indusia conspicuously inframedial, glabrous; annulus about 14-articulate; spores reniform.

Type in the U. S. National Herbarium, no. 1,618,695, collected at Roboré, Bolivia, altitude 416 meters, October 1934, by M. Cárdenas (no. 3006).

The alliance of this species is clearly with *Blechnum asplenioides* Sw., which it resembles habitally and in its small size, basally attenuate blades, and adnate segments. The two may be distinguished as follows:

Stipes slender, glandular-pilosulous; rachis and leaf tissue glandular-pilosulous; segments slightly longer than broad, rounded and mucronulate at apex; veins 4 pairs ..... *B. delicatum*

Stipes shorter and stouter, glabrous; rachis and leaf tissue glabrous, thicker; segments obviously longer than broad, acute or acuminate; veins about 6 pairs ..... *B. asplenioides.*

Struthiopteris brasiliensis (Raddi) Maxon & Morton, comb. nov.

Lomaria brasiliensis Raddi, Pl. Bras. **1**: 50. *pl. 72, 72 bis.* 1825.

Blechnum Raddianum Rosenst. Hedwigia **46:** 91. 1906.

This species has not previously been recorded from Bolivia. It was collected at Okara, alt. 2250 meters, Apr. 26–29, 1926, by Tate (no. 938), and at Sirupaya, Yungas, alt. 2250 meters, by Buchtien (no. 467). The latter was determined by Rosenstock as *Blechnum capense* (L.) Schlecht., an Old World species.

Struthiopteris Buchtienii (Rosenst.) Maxon & Morton, comb. nov.

Blechnum Buchtienii Rosenst. Repert. Sp. Nov. Fedde **5:** 231. 1908.

Founded on *Buchtien* 878, from Unduavi, northern Yungas, and apparently not uncommon in Bolivia at elevations of 3000 to 4000 meters, e.g. *Tate* 357, from Cocopunco. In Peru Señor C. Bües found it at Cerro Colca, Valle de Lares, alt. 4000 meters (no. 1878), and it is reported also from Ecuador. Among Bolivian species it is readily distinguished by the long, stiff, linear scales of the caudex.

Struthiopteris penna-marina (Poir.) Maxon & Morton, comb. nov.

Polypodium penna-marinum Poir. in Lam. Encycl. **5:** 520. 1804.

Blechnum penna-marinum Kuhn, Fil. Afr. 92. 1868.

This characteristic species is chiefly antarctic in distribution, but has been collected several times in Bolivia at high elevations (3000–3900 meters). Mr. Tate found it at Pongo (nos. 118, 119, 844).

Dicranopteris boliviensis Maxon & Morton, sp. nov.

Rhizoma repens, minute tuberculatum, paleis rigide ciliatis castaneo-fuscescentibus elongato-deltoideis nitentibus crassis 3–4 mm. longis deciduis onustum. Folia erecta, umbraculiformia; stipes 50 cm. longus, castaneo-fuscescens, basi tuberculatus, glabrescens; lamina suborbicularis, ca. 20 cm. longa et lata, 4- vel 5-dichotoma, numquam trichotoma, axibus medialibus abortivis, gemmis inclusis dense paleaceis, internodiis 3.5–1.5 cm. longis, nudis, vel ultimis 2–4 segmenta parva interdum ferentibus; pinnae lineares, usque ad 16 cm. longae et 1.5 cm. latae, subpinnatisectae, costis paleis laxe ciliatis castaneis elongatis praeditis; laciniae pruinatae, lineares, acutae, basi connata 3 mm. latae, sursum vix 2 mm. latae, rigide herbaceo-coriaceae, concavae, marginibus valde revolutis, costulis laxe fibrilloso-paleaceis; venae paucae, prominulae supra; sori mediales, sporangiis ca. 4 formati.

Plants small. Rhizome wide-creeping, 3 mm. in diameter, bluntly tuberculate (tubercles 0.5–1 mm. long), deciduously paleaceous; scales 3–4 mm. long, 1 mm. broad, narrowly triangular from a rounded base, attenuate, very dark castaneous, thick, rigidly ciliate. Fronds erect, umbraculiform; stipe 50 cm. long, 3 mm. thick, very dark castaneous, deciduously scurfy, tuberculate at base, not extended as a primary axis; blades about 20 cm. long and broad, 4 or 5 times dichotomous, the included buds (with a single exception) dormant,

not producing minor axes; internodes about 3.5 cm., 2.5 cm., 1.5 cm., and 1.5 cm. long respectively, diverging at an angle of about 60°, naked, or the ultimate ones bearing 2–4 reduced segments on the inner side; buds relatively large, the closely imbricate scales similar to those of the rhizome but thinner, paler, and bearing numerous very long, lax, whitish cilia; pinnae narrowly linear, 8–16 cm. long, 8–15 mm. broad, long-attenuate, very deeply pinnatifid throughout or sometimes naked a distance of about 1 cm. at outer base; rachises persistently paleaceous, the scales similar to those of the buds, spreading, 1.5–2 mm. long, laxly ciliate; segments numerous (35–50 pairs), slightly oblique, linear, 5–9 mm. long, 3 mm. broad at base, concave (the margins strongly revolute), 1.5–2 mm. broad at middle, acute, the costule elevated beneath, fibrillose-paleaceous, a few fibrils extending to the veins; veins 9–11 pairs, mostly once-forked, evident above; immersed beneath; sori medial, mostly 4-sporangiate. Leaf tissue rigidly herbaceo-coriaceous, strongly pruinose beneath.

Type in herbarium of the New York Botanical Garden, collected at Cocopunco, Cordillera Real, Bolivia, alt. 3000 meters, March 24–29, 1926, by G. H. H. Tate (no. 351). Duplicate in U. S. National Herbarium.

In architecture, especially in the non-development of primary and minor axes from the included buds of the dichotomies, *D. boliviensis* somewhat suggests *D. rubiginosa* (Mett.) Maxon, of Colombia and Venezuela, in miniature. That species differs greatly otherwise in having the primary branches only once or twice dichotomous, the first internodes naked or partially pectinate, the second internodes often fully pectinate, and the rachises clothed with fulvous or ferruginous, rigidly ciliate scales, the cilia ferruginous or often darker.

United States National Museum
Washington, D. C.

On the Genus Cyclodium[1]

C. V. Morton

The South American fern genus *Cyclodium* has not had quite as varied a nomenclatural history as most genera of the tribe Dryopterideae. Since its establishment by Presl[2] in 1836 it has almost invariably been recognized as valid, except by Hooker and Baker, who reduced it to a section of *Aspidium*. Presl distinguished his genus from *Nephrodium* by its anastomosing venation and orbicular, peltate indusium. He cited three species: *C. glandulosum* (founded on *Aspidium glandulosum* Blume), *C. confertum* (founded on *Aspidium confertum* Kaulf.), and *C. meniscioides* (founded on *Aspidium meniscioides* Willd.). Inasmuch as the first of these has a reniform indusium, attached at the sinus, it can not be taken as the type of the genus. The Willdenow species has rightly been taken as the type, that of Kaulfuss having usually been regarded as a synonym.

Considering Presl's tendency to multiply genera and the limited number of species known to him, *Cyclodium* must be considered as having been relatively well founded. It may be doubted, however, if recent fern students have carefully considered its claims to generic standing. During a study of certain recent collections it became apparent to me that a proper distinction from *Dryopteris* is lacking, and in order to clarify the following discussion I give here a brief summary of the important characters of *Cyclodium*.

It is a fern with imparipinnate fronds of papery or subcoriaceous texture, with alternate subentire pinnae. The lateral veins are numerous and almost straight, and spread at a broad angle. The four to six pairs of secondary veins diverge at an acute angle and anastomose with the opposing vein. The two united veins then go out in an excurrent veinlet, which may or may not be united with the next succeeding pair of veins; and this is the type of venation that has come to be known as meniscioid. The sori arise in two rows between the lateral veins, being borne on the secondary veins about midway between origin and point of anastomosis. They are rotund, and possess an orbicular, centrally attached, subcoriaceous indusium. In the variety *conferta* the fertile pinnae are contracted and the sporangia often cover the under surface, but in typical *C. meniscioides* this is not true. The blades of both are glabrous throughout, sparsely paleaceous, and conspicuously pellucid-punctate. The outermost veinbranches are united throughout and do not reach the margin.

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[2] Tent. Pterid. 85. 1836.

The venation just described can not be considered as separating *Cyclodium* from *Dryopteris*. Indeed, this type of venation is most typically developed in *Dryopteris*, where it is found in three different subgenera: *Meniscium*, *Goniopteris*, and *Stigmatopteris*. There is nothing unusual about the sori, except the circular indusium and its peltate attachment, but these too are found in subgenus *Stigmatopteris*, section *Peltochlaena*.

The following characters are enumerated by Christensen[3] as distinguishing *Stigmatopteris:* (1) The sporangium in falling is loosened from its pedicel, which remains fixed to the receptacle. This is true also in *Cyclodium*, but may not be a very important character. (2) The veins never reach the margin and often anatomose. (3) All species are entirely glabrous but more or less paleaceous. (4) The lamina is pellucid-punctate. (5) The pinnae terminate in a sharply serrate apex. This is not true in *Cyclodium*, but can hardly be considered a generic character. (6) The apex is pinnatifid. The blades are imparipinnate in *Cyclodium*. This can not be considered a generic criterion, since imparipinnate blades are characteristic of *Dryopteris*, subgenera *Meniscium* and *Goniopteris*, sect. *Eugoniopteris*.

Thus it is seen that there is no important difference whatever between *Cyclodium* and *Stigmatopteris*. The latter is now recognized by Christensen as generically distinct from *Dryopteris*. In such a usage, however, the name itself is invalidated by *Peltochlaena* Fée, validly published for a species now included in *Stigmatopteris*. One solution of the problem would be to unite these two genera in one, under the older name, *Cyclodium*, characterized by the peltate indusium and glabrous pellucid-punctate blade, with veins not reaching the margin. However, such an aggregation of species would be highly unnatural. Already *Stigmatopteris* as recognized by Christensen includes a number of anomalous species, such as *S. opaca* (*Dryopteris Christii*), *S. varians*, and *S. guianensis* (*Dryopteris subobliquata*), that are certainly not very closely related to *S. rotundata* or *S. caudata*, or others of the principal group of species. The further inclusion of *Cyclodium meniscioides* would render the group entirely artificial, and it is not here suggested that *Cyclodium* is phylogenetically very close to such a species as *Stigmatopteris rotundata*. In fact, it seems likely that in origin *Cyclodium* is closer to *Goniopteris* or *Meniscium*. However, as a matter of convenience, it may be referred to *Dryopteris* subgenus *Stigmatopteris*, since, as pointed out, that subgenus is already a heterogeneous assemblage.

The reduction of *Cyclodium* to *Dryopteris* is not new here. That was done in 1891 by Otto Kuntze; but inasmuch as he gave no discussion of the matter, his views have been ignored.

[3] Bot. Tidskr. **29**: 292–294. 1909.

The following key to those species of *Stigmatopteris* with peltate indusia and anastomosing veins is offered. This is an artificial grouping. In fact, *D. clypeata* may not properly be included in *Stigmatopteris* at all, because of the presence of hairs. It is an anomalous species of uncertain relationship, but shows in gross form a certain similarity to *Cyclodium meniscioides*.

KEY TO SPECIES

Blades pinnatifid at apex, i.e. without a conform terminal pinna.
Pinnae sharply serrate to the acuminate apex; basal veinlets anastomosing.....1. *D. varians.*
Pinnae lightly crenulate; basal anterior venule free (venation subgoniophlebioid)
2. *D. calophylla.*
Blades imparipinnate, the terminal pinna conform; venation meniscioid.
Costae and veins glabrous beneath, somewhat paleaceous; areoles 4–6-seriate; pinnae acute or short-acuminate.
Pinnae strongly ascending, the sterile not over 9 cm. long and 2.1 cm. broad, finely and evenly serrulate almost to base.....3. *D. paludosa.*
Pinnae patent, the sterile 13–25 cm. long and 4–8 cm. broad, subentire to lightly undulate.
Blades nearly conform, the fertile 11–17 cm. long, 2.5–4 cm. broad, the sporangia never confluent over the surface, the margin subentire or irregularly sinuate-crenate
4. *D. meniscioides.*
Blades subdimorphic, i.e. the fertile pinnae contracted, not over 10 cm. long and 1.5 cm. broad, the sporangia numerous and more or less covering the surface, the margins usually deeply and regularly crenate throughout...4a. *D. meniscioides* var. *conferta.*
Costae and veins beneath puberulous, not paleaceous; areoles 14–17-seriate; pinnae cuspidate-acuminate.....5. *D. clypeata.*

1. DRYOPTERIS VARIANS (Fée) Kuntze, Rev. Gen. **2:** 814. 1891.
Nephrodium varians Fée, Mém. Foug. **11:** 88. *pl. 24, fig. 2.* 1866.
Dryopteris varians Kuntze, Rev. Gen. **2:** 814. 1891.
Stigmatopteris varians Alston, Kew Bull. Misc. Inf. **1932:** 309. 1932.

This rare species was described from Trinidad, from which locality I have examined two specimens, one from the Trinidad Botanic Gardens Herbarium (no. 1225) and one collected on border of forest stream at Aripo Savanna by N. L. and E. G. Britton (no. 2941). Otherwise it is known to me only from the Mazaruni River, British Guiana (*Jenman* in 1899, *de la Cruz* 2880).

2. **Dryopteris calophylla** Morton, sp. nov.

Rhizoma ignotum; frondes fertiles usque ad 1.5 m. altae, steriles latiores ca. 1 m. altae; stipites straminei sulcati glabri, parce paleacei, paleis linearilanceolatis glabris atrobrunneis, margine parce fibrillosis; rhachis 63–68 cm. longa straminea glabra, supra sulcata, paleacea, paleis lineari-subulatis subpersistentibus instructa; lamina pinnata sed non imparipinnata, pinnis superioribus gradatim minoribus et in apicem pinnatifidum demum subintegrum reductis; pinnae 15–18-jugae, alternae, fere horizontaliter patentes papyraceae, fere concolores, pallide virides, pellucido-punctatae, lineari-

lanceolatae, maximae ca. 21 cm. longae et 3.5 cm. latae, apice acuminatae sed non caudatae, basi rotundatae, paullo acroscopicae, pinnis majoribus evidenter petiolulatis (usque ad 7 mm.), steriles subintegrae vel leviter crenulatae, fertiles crenatae; costa subtus glabra, straminea paleacea, paleis persistentibus subulatis, saepissime apicem versus cellulis uniseriatis praedita; nervi laterales 40–60-jugi, inter se 3.5–5 mm. distantes, leviter flexuosi vix arcuati, paleis parvis subulatis sparse instructi; venula anterior basalis libera, venulis ceteris (ca. 3) cum oppositis anastomosantibus, venula excurrente saepe cum venula exteriori proxima conjuncta, marginem versus venulis irregulariter anastomosantibus, mesophyllo glabro; sori inter nervos laterales biseriati, alterni, in venulis submediales, receptaculo rotundo non elongato elevato; indusium orbiculare peltatum coriaceum subpersistens glabrum.

Type in the U. S. National Herbarium, nos. 1,662,621–3, collected in the vicinity of Barranca Bermeja, Magdalena Valley, Department of Santander, Colombia, altitude 100–500 meters, Sept. 4, 1934, by Oscar Haught (no. 1353).

3. **Dryopteris paludosa** Morton, sp. nov.

Rhizoma ignotum; rhachis et stipes brunnei sulcati glabri, parce paleacei, paleis mox deciduis lineari-subulatis brunneis clathratis glabris instructi; lamina lineari-lanceolata, sterilis ca. 40 cm. longa, fertilis ca. 50 cm. longa, imparipinnata; pinnae 12-jugae, angulo acuto adscendentes, alternae, fere conformes, oblongo-lanceolatae, usque ad 9 cm. longae et 2.1 cm. latae, chartaceae, apice acutae nunquam acuminatae, basi obtusae, superiores sessiles, inferiores brevissime petiolulatae (ca. 3 mm.), utrinque glaberrimae, costa costulaeque parcissime paleaceae, paleis lineari-subulatis deciduis, margine pinnarum sterilium fere usque ad basin regulariter serrulata, fertilium grosse crenata; nervi primarii 30–40-jugi recti, non arcuati, marginem non attingentes, nervis secundariis 4–6-jugis cum oppositis in venula excurrente anastomosantibus, areolis obliquis inaequilateralibus; sori inter venas biseriati, in venulis saepe mediales, receptaculo rotundato, nunquam elongato, paullo elevato; indusium orbiculare centrale peltatum subcoriaceum persistens glabrum; annulus 16–18-articulatus; sporae reniformes, ca. 60 μ longae et 40 μ latae; paraphyses nullae.

Type in the herbarium of the New York Botanical Garden, collected at Puerto Berrio, Department of Antioquia, Colombia, alt. 130 meters, Jan. 11–13, 1918, by F. W. Pennell (no. 3723).

4. DRYOPTERIS MENISCIOIDES (Willd.) Kuntze, Rev. Gen. **2:** 813. 1891.
Aspidium meniscioides Willd. Sp. Pl. **5:** 218. 1810.
Cyclodium meniscioides Presl, Tent. Pterid. 85. *pl. 2, fig. 20.* 1836.
Nephrodium meniscioides J. Sm. in Hook. Journ. Bot. **4:** 188. 1841.

Soromanes integrifolia Fée, Mém. Foug. **2:** 82. *pl. 42.* 1845, as to sterile frond.

In the Index Filicum *Aspidium heterodon* Schrad.[4] is mentioned as a doubtful synonym, but from the description of the pinnae as sharply serrate at the apex it can hardly be referable here. I have seen the following specimens:

BRITISH GUIANA: Pomeroon River, *de la Cruz* 3119; Bartica, *de la Cruz* 1921; Kamwatta, *de la Cruz* 1177; Demerara River, *Jenman.*

BRAZIL: Tanaii, *Spruce;* Tapaná, near Pará, *Killip & Smith* 30331; without specific locality, *Glocker* 10.

PERU: Puerto Bermudez, Dept. Junín, *Killip & Smith* 26566; Santa Rosa, Dept. Junín, *Killip & Smith* 26165; Pongo de Manseriche, Dept. Loreto, *Mexía* 6193a.

4a. DRYOPTERIS MENISCIOIDES var. **conferta** (Kaulf.) Morton, comb. nov.

Aspidium confertum Kaulf. Enum. 232. 1824.

Cyclodium confertum Presl, Tent. Pterid. 85. 1836.

Nephrodium confertum J. Sm. in Hook. Journ. Bot. **4:** 188. 1841.

Aspidium Hookeri Klotzsch, Linnaea **20:** 364. 1847.

"*Cyrtomium confertum* Presl" ex C. Chr. Ind. Fil. 197. 1905. (Error for *Cyclodium*).

Cyclodium rigidissimum C. Chr. Bot. Tids. **25:** 79. 1902.

Most recent fern students have considered *Aspidium confertum* Kaulf. a synonym of *Cyclodium meniscioides*, but the differences in the fertile pinnae seem to require the recognition of the former as a variety. The sterile blades are indistinguishable. *Aspidium Hookeri* was founded on the plate of *Aspidium confertum* Kaulf. given by Hooker and Greville (Icon. Fil. *pl. 121.* 1829), which was supposed to be different from the original species of Kaulfuss. The two are certainly the same, however, the venation shown in the plate of Hooker and Greville being highly inaccurate. I have examined the following specimens:

VENEZUELA: Lower Orinoco, *Rusby & Squires* 377, 379.

BRITISH GUIANA: Waini River, *de la Cruz* 3844; Amakura River, *de la Cruz* 3488; Assakatta, *de la Cruz* 4302; Penal Settlement, *Hitchcock* 17124; Kangaruma-Potaro Landing, *Gleason* 183; Essequibo River, *Jenman.*

FRENCH GUIANA: Baduel, *Leprieur* 27.

BRAZIL: Tapaná, near Pará, *Killip & Smith* 30316; Pará, *Petelot* s. n.

[4] Goett. Gel. Anz. **1824:** 869.

PERU: Mischuyacu, Dept. Loreto, *Klug* 241.
BOLIVIA: San José, *Williams* 1191.
PARAGUAY: Alto Paraná, *Fiebrig* 6344; Caaguazú, *Hassler* 9049.

5. **Dryopteris clypeata** Maxon & Morton, sp. nov.

Herba terrestris, usque ad 82 cm. alta, frondibus fertilibus quam sterilibus longioribus; rhizoma breviter repens, parce paleaceum; stipites distichi usque ad 48 cm. longi, quam laminae longiores, rubro-brunnei, supra sulcati, glabri, basi paleacei, paleis lanceolatis brunneis clathratis, parce ciliatis, externe parce pilosulis (pilis simplicibus); lamina ovata imparipinnata; pinnae 4 vel 5, alternae, inferiores suboppositae, oblongae conformae, usque ad 22 cm. longae et 8.5 cm. latae, utrinque pallide virides et concolores, nitentes chartaceae, pellucido-punctatae, margine subincrassatae integrae vel leviter undulatae, apice subito cuspidato-acuminatae, superiores late et aequaliter cuneatae, inferiores basi superiori superioribus similes sed basi inferiori usque ad 1 cm. non foliaceae, breviter petiolulatae (3 mm.); costa rubescens puberula epaleacea, nervis lateralibus 30–40-jugis rubescentibus puberulis epaleaceis subrectis, marginem versus paullo arcuatis, marginem attingentibus, inter se 5–6.5 mm. distantibus, venis secundariis 14–17-jugis inter se 2–3 mm. distantibus subrectis vel saepe subsigmoideis, cum venulis oppositis anastomosantibus et in venula excurrente saepe libera prolongatis, mesophyllo glabro; sori inter venas laterales biseriati, submediales, receptaculo rotundo, non elongato, paullo elevato; indusium orbiculare centrale peltatum subcoriaceum subpersistens, margine non ciliatum, superficie parce pilosulum; annulus 17–19-articulatus; sporae reniformes, immaturae 44 μ longae et 21 μ latae; paraphyses nullae.

Type in the U. S. National Herbarium, nos. 679,433–4, collected on hills back of Puerto Obaldía, San Blas Coast, Panama, altitude 50–200 meters, August 1911, by H. Pittier (no. 4309).

UNITED STATES NATIONAL MUSEUM
WASHINGTON, D. C.

INDEX TO AMERICAN BOTANICAL LITERATURE

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

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